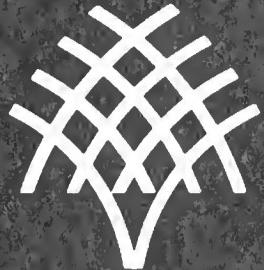


Digitized by the Internet Archive
in 2017 with funding from
IMLS LG-70-15-0138-15

<https://archive.org/details/greenthumb4619unse>

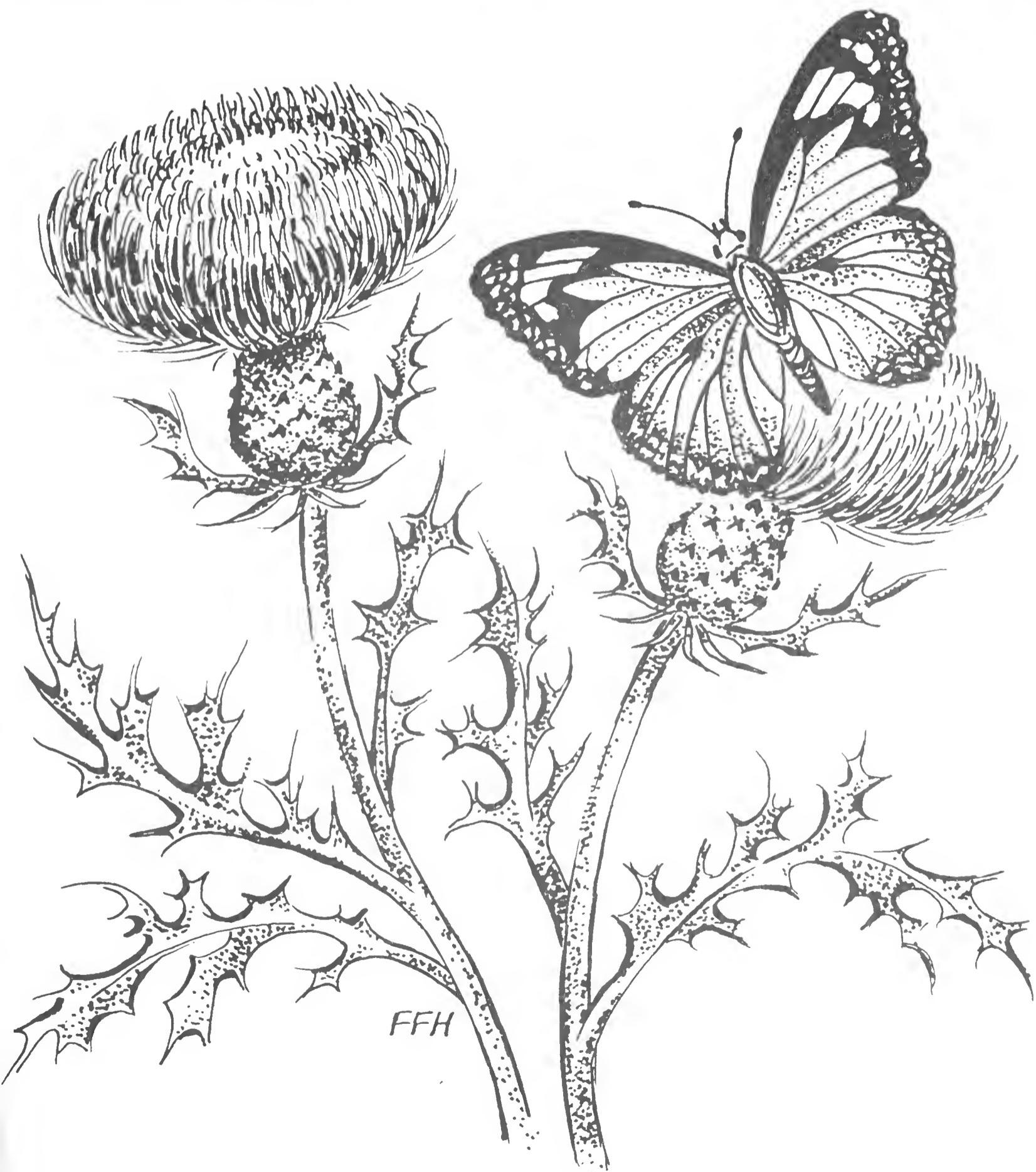


The Green Thumb



Spring/Summer 1989

Volume Forty-six
Number One



The Cover

Butterfly and Thistle
Frances Frakes Hansen

The Green Thumb

Spring/Summer 1989
Volume Forty-six, Number One

Contents

Published by
Denver Botanic Gardens, Inc.
909 York Street
Denver, Colorado 80206

Alcinda A. Cundiff, *Editor*
Merle M. Moore, *Executive Director*
Beatrice Taplin, *President*

Bridging the
Turn of the Century:
A Vision for Denver
Don and Carolyn Etter

1

Ornamental Grasses
Gayle Weinstein

13

Carolyn Crawford,
Botanical Illustrator
Bernice Petersen

16

The Center for
Plant Conservation:
Saving the Future
Carol Dawson

19

Exotics of Colorado —
Smooth Brome
Helen Marsh Zeiner

22

Attracting Butterflies to
the Eastern Colorado Garden
Paul A. Opler
and Whitney S. Cranshaw

24

Watching Butterflies
Alcinda A. Cundiff

29

Copyright 1989
by Denver Botanic Gardens, Inc.
ISSN 00431108

Flowering Maple
Carolyn Crawford inside back cover

Bridging the Turn of the Century: A Vision for Denver

by Don and Carolyn Etter

This is an essay on our physical environment, and in particular on Denver's urban landscape. Our object is to present a point of view, a perspective, a way to think about the future of this place we call Denver. To this end, we're going to focus on the vision of the peoples who have occupied this place, for it is that vision which has molded, and which will continue to mold, the stage where we play out our lives. And it is the impact of that vision, or in some cases lack of vision, which makes the difference between whether or not our city continues to be livable in the face of an incredible array of metropolitan pressures.

Our thesis has three parts. First, we believe that a vision is already in place, a vision of what the community wants this city to be in the 21st century. Second, we believe that the Denver community has already made a substantial commitment to that vision and is already shaping its urban environment to conform to that vision. Third, we believe that this community has already built a bridge into the 21st

century, a bridge which is a superb foundation for the next 100 years.

Chaucer, Cervantes, T.S. Eliot and others confirm that any vision is a complex mixture of our memories and our desires, that any vision partakes both of the past and the future, and that the past is the context within which any vision of the future is framed. Thus, to understand our thesis, we need to explore our past. In particular, we're going to explore the two distinct visions which have molded this place and provided us with an extraordinary and unique urban legacy.

Don and Carolyn Etter are the Manager of the Denver Department of Parks and Recreation, and Honorary Lifetime members of the American Society of Landscape Architects. This essay was adapted from an invited address given by Mr. and Mrs. Etter at the Denver Botanic Gardens Annual Meeting on February 22, 1989. Permission to quote from the work of Tom Ferril was kindly given by Anne Ferril Folsom.

Some of the late Tom Ferril's words are recorded in the rotunda of The Colorado State Capitol. Those words are a fine framework and a thoughtful text for an exploration of our collective memories and our collective desires. In addition, those words are the most evocative ever written about this place:

*Here is a land where life is written in water,
The West is where the water was and is,
Father and son of old, mother and daughter,
Following rivers up immensities
Of range and desert, thirsting the sun-
down ever,
Crossing a hill to climb a hill still drier,
Naming tonight a city by some river
A different name from last night's
camping fire.*

*Look to the green within the mountain cup,
Look to the prairie parched for water lack,
Look to the sun that pulls the oceans up,
Look to the cloud that gives the oceans back,
Look to your heart and may your wisdom grow
To power of lightning and to peace of snow.*

*Men shall behold the water in the sky
And count the seasons by the living grasses.*

*Then shall the river namers track the sunset,
Singing the long song to the Shining Mountains.*

*Here shall the melting peaks renew the oxen,
Here firewood is and here shall men build cities.*

*Water shall sluice the gold yellow as leaves
That fall from silver trees on silent hills.*

*And men shall fashion glaciers into greenness
And harvest April rivers in the autumn.*

*Deep in the earth where roots of willows drank
Shall aqueducts be laid to nourish cities.*

*Water the lightning gave shall give back lightning
And men shall store the lightning for their use.*

*Beyond the sundown is tomorrow's wisdom,
Today is going to be long long ago.*

A Mother Earth Vision

Leaving aside Genesis, the first vision of this place was that of the Plains Indians, most recently the Arapahoe and Cheyenne. These groups of people from Asia were part of the first great migration to North America. Theirs was, in New Age terminology, a Gaia or Mother Earth vision. This vision resulted in stewardship of the land. These peoples saw themselves as a part of a natural world where all living things — prairie, mountain, man and woman, buffalo, water and sky — are one. And they lived within the limitations presented by nature. Like Thoreau, they lived richly by wanting little. For them, this place was livable.

This Gaia vision can in part be deduced from the traditions held in common by various Native American tribes. More to the point, the vision can be deduced by reading the land. These Asian immigrants were stewards of this place for over 20,000 years. Yet, when their dominion was rudely ended, the land had been essentially unchanged by human action. By all evidence, they left the land largely as they found it.

The legacy of the Asian migration, then, consists of the untouched qualities of this remarkable part of the globe.



Landscape from an early journal of Rocky Mountain exploration.

A dry blue sky. These immigrants didn't create a brown cloud; they didn't punch dangerous holes in our atmosphere.

The High Plains. The land flowered in the spring and supported the buffalo herds which in turn supported the people of the plains.

The creeks and gulches. The small, pure streams supplied fish and even the summer-dry washes supported cottonwood groves, places for shelter from the sun and the wind. These immigrants didn't plough the thin topsoil into a dust bowl; they didn't harvest our forests or leave behind erosion and a "greenhouse effect."

The great Rocky Mountain backdrop. These immigrants didn't dump tailings of mine or factory indiscriminately across the land. These immigrants built nothing to block our view of these spectacular mountains.

Here and there a trained archeologist can trace these people, a hint of an ancient trail or the charred remains of a campsite. But even the great Keota stone circles in Northeast Colorado are almost

impossible to find. These few faint marks tell us that these peoples simply tiptoed rather silently across the landscape.

The Settlement Vision

The great European migration to North America was ultimately to displace the Native Americans and their vision. The harbingers of this migration made this clear. They recognized the essential characteristics of the land. But their expectation was to profit from the land.

Beginning in the late 16th and early 17th century, *los conquistadores* recognized the brilliant light and enormous scale of the landscape. They left with us names like Colorado and Sangre de Cristo, for the red of the soil and the sunsets, and Grande for a river which was. But what they sought was El Dorado. Beaver pelts were the wealth sought by the French trappers. On their way to the great Rendezvous of the early 19th century, these Frenchmen named a flat river "Platte" because it was. They called the High Plains "prairie" for they knew that, in this dry land, water would make this meadow bloom.

Then the Yankees came. Generals, Majors and Lieutenant Colonels came to seek a series of routes and outposts to frame the course of America's manifest destiny. Their names were left on the mountain backdrop. And finally the scientists, artists and cartographers came, from the East and from Europe. They came to extract knowledge from this land. They extracted images which would mold the attitude of the entire world toward this place, images which would enchant and attract successive generations.

But these people were only the harbingers. It was not until 1858, as we all know, that the great European migration actually reached Denver in a rush to the gold fields. This migration came in successive waves over the first 100 years of Denver's history. At first, they came on foot, on horseback and by covered wagon. They came in search, first of gold, and then as one boom succeeded another, silver, gold again, uranium and oil. After 1870 they came in increasing numbers by train until, in 1945, 60 trains a day stopped at Denver's Union Station. They came to build sawmills and business blocks, banks and hotels, and they came to farm the land. They came to bathe in the mountain hot springs, to breathe fresh air and to recover from tuberculosis. Indeed, as early as the 1880s, Denver was touted as a haven for "play, rest and relaxation." In the decades after 1900, they came by automobile as well. They came to enjoy the cleanest city in America, to tour its nationally renowned parks and gardens, and then to strike out for the Rocky Mountains. In the 1930s they started coming by air, ultimately in droves to ski, and in the aftermath of World War II they came to live in one of the most livable cities in post-War America.

These people came from farms in Ohio and Iowa, from New England villages and the plantations of the South, from the tenements of New York, the mine fields of the mountains and the beet fields of the Platte Valley. They left societies with little room at the top; they left petty and

grand tyrants in Europe; they left memories of Monte Cassino and the South Pacific. Yet with all these differences in origin and motivation, these people had one thing in common. Their memories and desires coalesced into a common vision of settlement, a vision of what a city should look like, how a city should feel, what makes a city livable. In the first 100 years after 1858, they nurtured that vision. Against extreme odds, they imposed that vision on the land. In search for a livable landscape, they created an urban utopia.

This vision of settlement is rendered in the landmark Western, "*Cimmaron*," a film which Pauline Kael calls a numbskull trek through America's heritage. One scene in this 1931 film sums up the vision. Richard Dix has just returned to Wichita from the Cherokee strip. Dix excitedly describes the boom towns being laid out, the overnight establishment of the institutions of civilization. His wife, the fragile and indomitable Irene Dunn, is reluctant to leave the established, livable sophistication of Wichita and is persuaded to move to Oklahoma only after Dix promises her a garden and a tree. This *Cimmaron* vision, this vision of settlement, is the vision of Denver's first 100 years. The components of this vision are really just as simple as the film.

The first component of this vision was the great American locational imperative, the gridiron of blocks and lots relentlessly laid out in town after town across the West. Denver was no exception. Each of the three towns founded at the confluence of the Platte and Cherry Creek was laid out on a separate gridiron. Within a few years, a uniform North-South grid was imposed over the three original plats. It is this North-South grid which ultimately came to dominate the entire metropolitan area. The grid served the rational needs of promoters, for it made the land easy to divide up and sell. It served the utilitarian needs of government, for it made it easy to plan and deliver essential services such as water and

electricity. The grid served citizen needs for it was ultimately understandable as a locational directive. In addition, the grid was, and is, a physical embodiment of Jeffersonian democracy. In the grid, there is no hierarchy of spaces and all spaces are directly accessible to all citizens.

The second component of the settlement vision was the reservation of series of squares to be occupied by key public institutions. Virtually every 19th century plat of a new Western town had squares reserved for a courthouse, the civic symbol of law and order, and for parks, the civic symbol of civilization. Thus it was that the three grids laid out in 1858 at the confluence of the Platte and

Cherry Creek had several squares set aside for parks and a courthouse. A decade later, Curtis Park was given to the city and, thereafter, the city embarked on a substantial program of acquiring additional blocks for parks, including City Park and Lincoln Park. In downtown Denver, entire blocks were devoted to the construction of Denver's City Hall, a United States Custom House and the Arapahoe County Courthouse.

The third component of the settlement vision is what has been called Denver's civic symbol, the street tree. In 1865, work was begun on construction of the city ditch. That ditch was part of a remarkable engineering feat designed to bring water to the prairie. As you all



Early Denver: Glover's Bird's Eye View, 1874.

know, in this climate, no garden, no tree can survive without application of water. St. Louis and Philadelphia each have about 40 inches of precipitation a year, compared to our semi-arid 14 inches. Water from the City Ditch reached Denver in the spring of 1867 and, at the same time, wagonloads of cottonwoods from Kansas City arrived. It quickly became *de rigueur* for individual homeowners to plant street trees. Developers followed suit and planted street trees to promote residential development. As the decades passed, street trees became a uniform design component which linked all parts of the city. The resulting arcadia became a symbol of livability.

If street trees provided the canopy for our oasis, the settlement vision was completed and embellished with an oasis floor. This was Irene Dunn's garden, an English image of lawn and flowers, of fence and dooryard. The pattern was firmly established from the outset. Reading from the street to the front door, the components were uniform: first there was the ditch, sometimes curbed, and initially used to provide water for the street trees; then a tree lawn, or parking, set out with street trees and, sometimes, hitching posts; then there were sidewalks — originally boardwalks, later red sandstone, and ultimately grey concrete; sometimes there was a fence, and then



6 The City Ditch still runs in Washington Park.

there was a lawn, with a home set back and framed with flower beds. This was a miniature, urban version of the common image of a grand English estate. The pattern was repeated in every corner of the city. It was carried into the back yard. It was reflected in public spaces as well as private: witness the 19th century front yard of Union Station and the flower displays in the City Park Esplanade.

Thus it was that within two decades of the founding of Denver, the basic components of the settlement vision, the grid, public squares, street trees and gardens

were in place and were being nurtured by common consent. No referendum had been necessary to create this rather incredible imposition of our collective will on the land. No referendum had been necessary to create this manifestation of our collective memories and desires. But Denver's 20th century urban landscape can't be explained merely as a collection of the artifacts of this 19th century vision. It is obvious that something more complex, more sophisticated and more exciting was at work.



Denver bungalows without and with street trees.



The City Beautiful Movement

The answer can be found in the two decades that bridge the turn of the last century. The Great White City of the 1893 Chicago Columbian Exposition is often thought of as the starting point. Certainly, that exposition was the seminal model for the City Beautiful Movement. This was the time of innovation, of excitement and of imagination. On the international scene, America was emerging as an imperial power; on the intellectual scene, we were in the midst of what has been called the "American Renaissance;" and on the urban scene, American cities were being reshaped by the City Beautiful Movement. We've never found a very satisfactory definition of the City Beautiful Movement, but certainly its watchwords were beauty, utility, livability and harmony, and there is no doubt that during this time the city itself became an art form.

The impact of the City Beautiful Movement on Denver was unique. Rather than sweep away the past, the Movement built on and reinforced traditions already in place. Rather than ignore the setting of the city, the Movement acknowledged and highlighted the essential elements of Denver's environment.

In fact, the City Beautiful Movement in Denver actually turned the Cimarron vision into an art form. The gridiron was viewed not as a constraint, but as an appropriate foundation for urban design. Thus, a system of parkways were built on the gridiron, thereby linking the city's 19th century parks into a citywide system. Parkways were built to link schools, libraries and other public buildings into the park and parkway system. First-rate landscape architects were engaged to design parks. Stunning gardens and a wide variety of trees and shrubs were planted in the parks. A monumental and imposing plaza was designed and built to serve as the hub of the park and parkway system. "Tree rows," as they were sometimes called, were planted along every street, around every park, in front of every pub-

lic building. Ultimately, those street trees were to frame the entire city.

The essential elements of our Denver environment were also incorporated into this City Beautiful system. Resident and visitor alike went to the parks to see the mountains, and platforms were built in the parks from which to view the mountains. We were encouraged to protect "grand views" which would otherwise be threatened by tall buildings. And, in perhaps the most foresighted step, we integrated the mountains themselves into our park system with the acquisition and development of the Denver Mountain Parks. This spectacular system of roads and parks was quickly recognized both as a destination and as a gateway to the Rocky Mountain West.

During these turn of the century decades, Denver also reaffirmed the Cimarron vision: to be livable, the city must be a watered, English landscape, an oasis with a canopy of trees and a garden floor. And in the minds of those very practical folks who taxed themselves for the privilege, livability was seen not only as a goal in itself, but as the foundation of prosperity. Water, our rarest landscape, was used in abundance, and beautifully, throughout the city, not only to water our trees and gardens, but for recreation, as an enhancement of our urban landscape and as the symbol of our choice.

Finally, during these decades, two key expectations emerged in the community. The first was that citizens would participate in fulfilling the vision for this city. The second was that the public sector would serve as a role model, that the city had a responsibility to set a high standard in architecture, in gardening, in recreation, indeed in every facet of the development of our urban environment.

In the decades that followed, this pattern was reinforced, expanded and embellished. On the eve of World War II, Denver was a premier example of the City Beautiful. Denver was known throughout the country as a comfortable city of homes, of street trees, of parks, of beauti-

ful lawns and gardens. Denver was rightfully recognized as one of the most livable cities in the country. But it was also clear as the decade of the 30s closed that an era was ending.

The Vision Blurred

In the years following World War II, we in Denver had to answer some tough questions. How can we accommodate a population explosion? How can we move automobiles more efficiently? How can we make room for the new? These, however, were the wrong questions. Worse, we mistakenly took the answers for a vision. We took sprawl for a vision; we took asphalt for a vision; we took the wrecking ball and the bulldozer for a vision. We took trees out of the formula. We took people out of the formula. The result was a sad impoverishment.

There were those who cried out. The preservationists told us that our future would be desolate without our past. But for the most part we saw these folk as sherry-drinking antiquarians. The environmentalists warned us of a silent spring. We saw these folk as quirky flower children. And so, with a few wonderful exceptions, we turned our back on the City Beautiful and allowed the vision of our settlement to blur.

Bridging the Turn of the Century

Which brings us into the 1980s and a vision for the future of Denver. Six years ago, the slogan "Imagine a Great City" was coined. Many were alternately critical and disappointed when no one stepped forth to spell out exactly what a great city was. Let us suggest, however, that such expectations may have missed the point. Take off your political hats for a moment and think of these words, "Imagine a Great City," not as a political slogan, but as a challenge to the community to take its own destiny into its own hands. We think that is exactly what has happened. This slogan has been taken as a challenge throughout the city.

There are many banner carriers. Citizen groups like Denver Urban Forest and The Park People; nonprofit boards and foundations, including the Denver Botanic Gardens; professional groups such as the Urban Design Committee of the American Institute of Architects and the local chapter of the American Society of Landscape Architects; environmental groups such as the Audubon Society and the Sierra Club; governmental agencies, including the Denver Parks and Recreation Department and the Denver Planning Office; citizen advisory bodies such as the Denver Planning Board; and individual citizens and neighborhood groups throughout the city. These groups, these individuals, are just now becoming aware that they are all talking the same language, that they are all setting the same goals, that they are all supporting the same projects. In short, they are just now becoming aware of their common response to the challenge and of their common commitment to the same vision, a vision which has grown out of consensus, out of our collective memories and desires. This, in turn, is welding them together. Together they are a force. And that is what is necessary to assure that the vision is put in place.

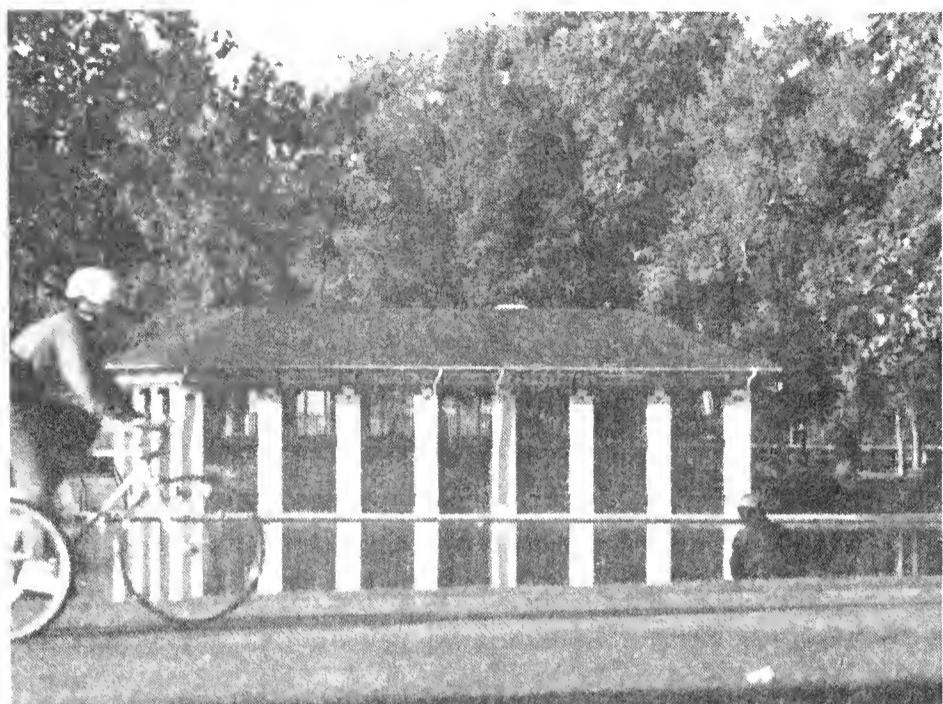
Because there is no single voice for this new vision, it's not easy to sort out the mix of memory and desire which it represents. But there are some common, very elemental threads which can be identified. First, the city is for people. Second, the city should be livable and prosperous. The corollary to this is that livability and prosperity go hand in hand. Third, the legacy of our City Beautiful should be protected, renovated and expanded. The corollary to this is that we want, as Bill Hornby said recently in the *Denver Post*, an amply watered environment. And fourth, beauty, quality and good design are not only desirable, but are compatible with considerations of function and cost.

Words or theories are not necessary to identify the vision, for both the vision and the commitment to the vision become

Trees around Civic Center and the refurbished Pioneer Fountain.



Restored Boathouse in Washington Park.



New streetscaping in Cherry Creek North.

New street trees and center divider plantings on East First Avenue.





Refurbished Thatcher fountain in City Park.



New Broadway bridge across Cherry Creek.

quite clear if we look at the pieces already in place. Once we see the pieces which are in place, we know that the vision is not just a pipe dream, that it is real. And we also know what pieces of the puzzle are missing and still need to be supplied.

When the history of the 1980s is written, you will be able to read about a phenomenal inventory of accomplishment. But if you take even a brief look at Denver today, you can actually see that inventory of accomplishment. And if you will think about this, you will know that the vision for Denver's future is already in place. A new city office building has been added to the Civic Center complex, a new convention center is under construction, and the aging Platte Valley viaducts are being replaced. Renovation of our historic park and parkway system has begun. New parks are under development in every quadrant of the city and more new parkways are being constructed than at any time since World War I.

People are being brought back into our urban equation. Sledding is back in the parks for the first time in nearly two decades, the city's one hundred and thirty playgrounds have been scheduled for rehabilitation, our metro trail system is being completed; streetscape planning again includes space for sidewalks; and Denver at night is again becoming a city of lights.

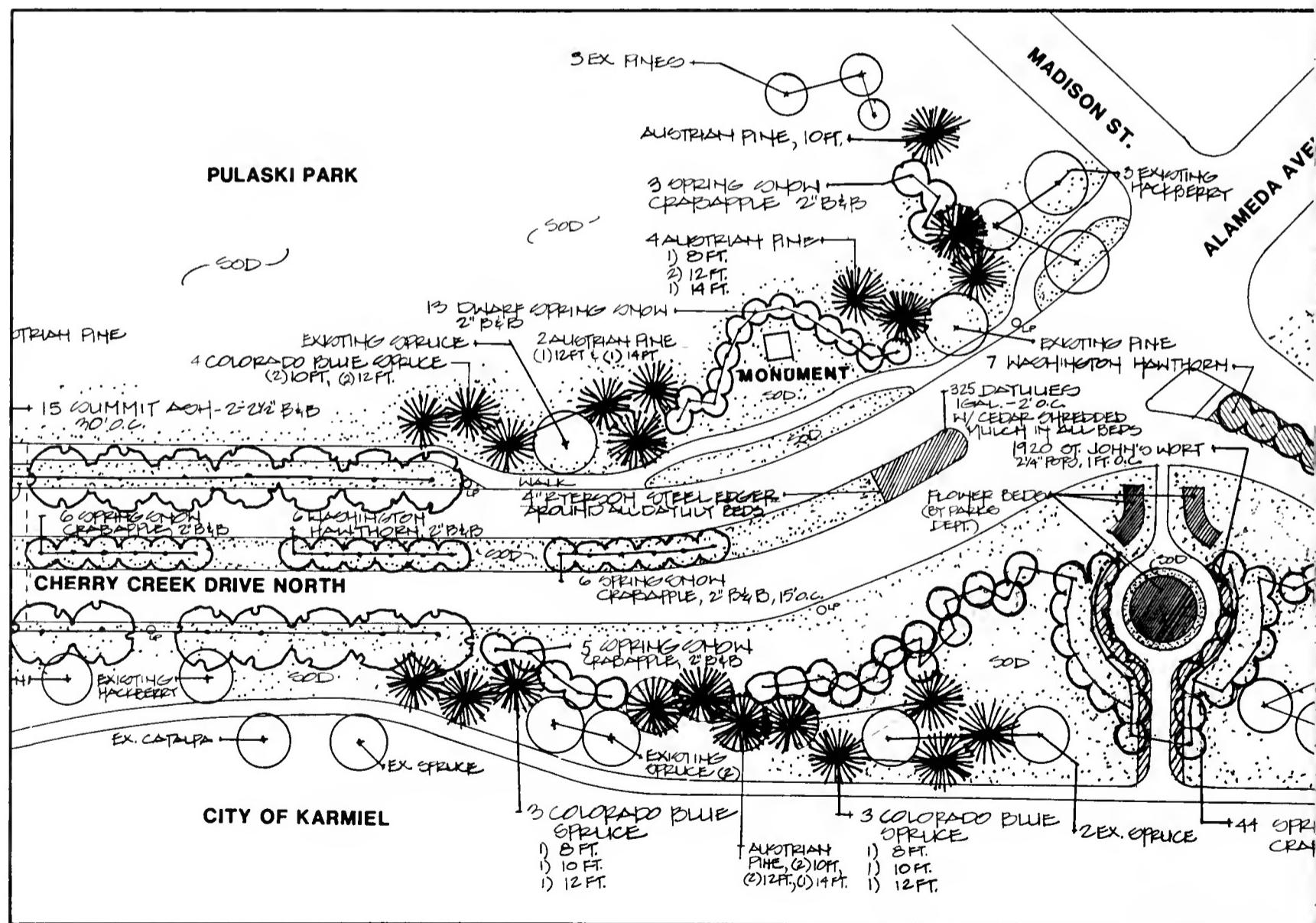
The list goes on. Notwithstanding a shrinking economy, Denver's renowned park gardens continue to be the most extensive in the country. For the first time in decades, our glorious fountains are being rehabilitated and our urban lakes are being revitalized. During the last year, more trees have been planted on city land than in any year since World War II. We continue to use water, but with increasing and appropriate care, so as to maintain our oasis, so as to maintain the livable city for which earlier generations worked and paid.

Our collective dreams for the future have already been converted into strategies: witness Denver's 1988 Comprehensive Plan which reaffirms the Cimarron vision, the 1989 Metro Mountain Recreation and Open Space Project which confirms our heritage of public lands, and the design of the new airport which will reflect Denver's City Beautiful traditions. The new Cherry Creek bridges and plans for the extension of Speer Boulevard are evidence of a renewed commitment to good design and to a city which is beautiful as well as functional. And a fundamental consensus has been reached that if the city is to be livable we must support our cultural institutions and we must repair our infrastructure.

The accomplishments of the 1980s are the bridge which this community has built into the 21st century. These accomplishments are the physical embodiment of our collective memories and desires, of our vision for the future. We are confident that this community now has the momentum to complete the unfinished agenda. We are confident that this community has the wit, the energy and the resolve to create a legacy for the 21st century which is as vibrant and livable as the legacy which we inherited.

Tom Ferril's words for the future, if you will remember them from the start of our journey, were:

*Beyond the sundown is tomorrow's wisdom,
Today is going to be long long ago.*



Cherry Creek North Parkway Plan.

Ornamental Grasses

by Gayle Weinstein

Neither mowed nor raked, but grown for full development of form, flowers and fruits are the ornamental grasses. Of approximately 40,000 species of grasses on earth, 100 have been selected for use in the garden.

Grasses are among the most adaptable plants in existence. They grow in a wide range of habitats and are major components of the tropical savannas, mid-latitude prairies and the tundra. They are used for lawns, hay, erosion control and are among the most important food crops of the world, including rice and wheat. Most recently, they have been revitalized and elevated to a place in the garden.

Their uniqueness in a garden results from the textural contrast they provide. Their leaves and flowers are generally finer and more delicate than other plants. Because the flowers are small and lack strong colors, they often create a cloud-like effect. The combination of their many leaves and fineness of texture shuffled by the wind adds motion and sound to the garden. To the flower arranger, many of these grasses are significant for compositions, fresh or dried.

The low maintenance of ornamental grasses speaks as highly for them as their beauty. They are widely adaptable to soils and growing conditions, require



Gayle Weinstein is manager of plant collections at Denver Botanic Gardens.

Big Bluestem.

minimum amounts of moisture and are practically pest free. They have dense, fibrous root systems that rejuvenate quickly. Their growing points are near or at the ground surface, protected from the fickleness of the atmosphere. Grasses are wind pollinated, fragrance free, lack bright colors and do not attract insects. Therefore, they can successfully be established and set seed independently of insect populations.

Ornamental grasses can be grown for attractive foliage, color, texture, growth habit, flowers, fruits, fall color and winter form. They range in size from a few inches high to 20 feet. Some grow in shade but most prefer full sun. Equally attractive in mass as they are alone, they can be bedded out or used as a mainstay in a perennial garden. When the killing frost lays down the perennials, the ornamental grasses still stand, displaying shades of golds, browns and reds.



To select the right grass for the garden, understand its growth habit. Many grow in bunches and break new buds at the base near the crown. Others have creeping stems that may travel beyond the desired limits. These are the ones to avoid or contain so that they do not invade territory where they are unwelcome.

The following list describes the ornamental grasses displayed at Denver Botanic Gardens. Perennials are available from local nurseries. Seeds for annuals can be ordered through many seed catalogs, available for reference in the library.

Perennial Grasses

Andropogon gerardii — Big Bluestem

Grown in the Plains Garden as part of the Tallgrass Prairie, it has been easy to establish. Its most outstanding feature is the bluish foliage that turns to shades of bronze; from 4 to 6 ft.

Arrhenatherum elatius var. *bulbosum* 'Variegatum' — Bulbous Oat Grass

Cream colored flowers; green with white striped foliage, the most ornamental feature; upright to open; no fall color; best in partial shade and in cool soils of spring and fall; common name from the bulbous nodes on the roots; from 12 to 16 in.

Bouteloua gracilis — Blue Grama

A native to short and midgrass prairies; flowers clustered in flaglike projections; color from tan to red; adaptable, serviceable plant as an ornamental, prairie and turfgrass; from 8 to 14 in.

Calamagrostis arundinacea — Feather Reed Grass

A clump forming grass; flowers green to pink to tan; foliage and form are delicate, upright and refined; tolerates most soils; sun or partial shade; attractive in foliage, flower and fruit; flowers good in arrangements; from 3 to 4 ft.

Chasmanthium latifolium — Northern Sea Oats

Flowers green fading to tan from summer through winter; upright to arching; best in partial shade and well drained soil; outstanding grass for dried arrangements; from 2 to 3 ft.

Elymus arenarius — Blue Lyme Grass

Flowers tan, not ornamental; foliage steel blue, glaucous; aggressive; must be seriously contained, but valuable for its foliage; from 2 ft.

Erianthus ravennae — Ravenna Grass

Flowers silvery white; foliage coarse; upright-open; fall color brown to tan; prefers full sun; outstanding for flowers and form; excellent for cutting; blooms in late August to September; can be somewhat aggressive; from 10 to 12 feet.

Helictotrichon sempervirens — Blue Oat Grass

Flowers tan, not ornamental; foliage light, steel blue with fine texture; tufted, clump forming; full sun to partial shade; most attractive for its foliage and form; from 2 to 3 ft.

Holcus lanatus — Velvet Grass

Flowers cream color; foliage soft, green and silky; somewhat open and floppy; best in late spring for flowers; from 12 to 15 in.

Miscanthus sinensis — Maidengrass

Attractive silvery to tan flowers; upright habit; fine to medium texture; winter habit outstanding; prefers full sun; attractive for fall flowers; excellent for cutting; many selections; from 4 to 8 ft.

Molinia caerulea 'Skyscraper' — Purple Moor Grass

Flowers yellow in 2-3 ft. spikes; foliage light green; upright form; fall color outstanding golden yellow; winter form succumbs to heavy snows; from 2 to 3 ft.

Panicum virgatum — Switchgrass

Native to tallgrass prairie; flowers dark red purple fading to tan; foliage green to blue; form is upright and narrow; fall color light to bright yellow; flowers excellent for drying; many selections; from 3 to 6 ft.

Pennisetum orientale — Oriental

Fountain Grass

Tall; clump form; fine texture; flowers pinkish to purplish; delicate, refined plant; excellent in mass; from 24 to 30 in.

Schizachyrium scoparium — Little Bluestem

A native grass in mid- to tallgrass prairies; upright form; flowers tannish; bronze fall color; good for prairie, ornamental and cutting; from 18 to 36 in.

Sorghastrum nutans — Indian Grass

Native to tallgrass prairies; upright form; medium texture; outstanding yellowish flowers and golden fall color; good for cutting; from 3 to 6 in.

Annual Grasses

Pennisetum longistylum — Fountain Grass

Upright arching; white flowers in July; excellent in mass; best in full sun; 24 in.

Pennisetum setaceum — Fountain Grass

Upright; purplish flowers in July; excellent in mass; best in full sun; from 24 to 36 in.

Rhynchospora neriglume — Ruby Grass

Glaucous blue foliage; clump former; silky pink flowers in late July; blooms until hard frost; not widely available; from 2 to 3 ft.

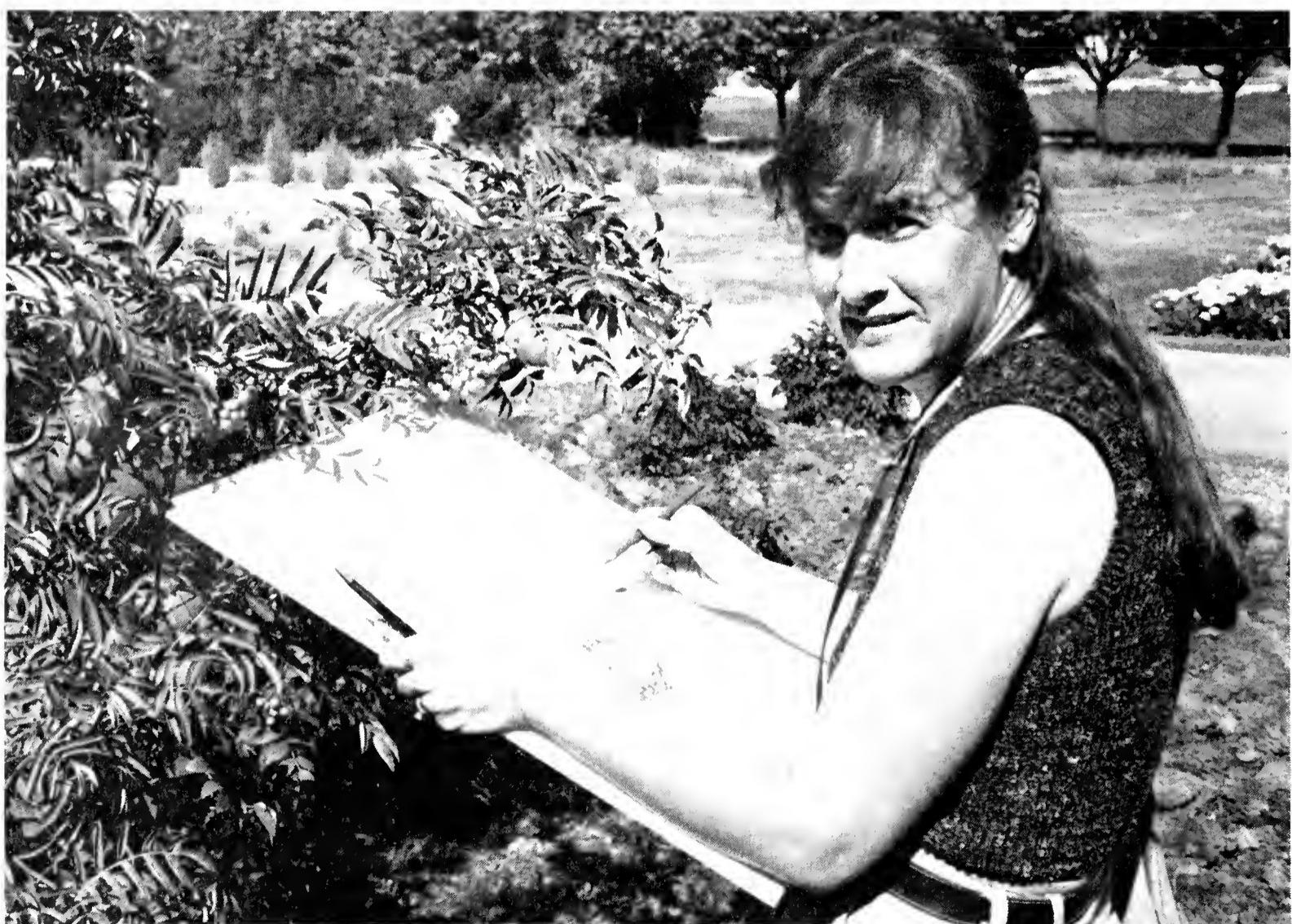
Rhynchospora repens — Ruby Grass

Flowers deep pink fading to pale pink or white; flowers in July; upright plant with graceful flower stalks; foliage pale green; long blooming plant; best in full sun; from 3 to 5 ft.

Carolyn Crawford, Botanical Illustrator

A stroll through the Rock/Alpine Garden at Denver Botanic Gardens almost eight years ago was a double win. For Carolyn Crawford, it was a discovery of the intrinsic beauty of the charming alpines and other miniature plants growing there. For Denver Botanic Gardens and associated plant societies, it was the discovery of a gifted artist who would generously share her talents as a botanical illustrator.

During the ensuing years, Carolyn has completed 268 color renderings — plant portraits ranging from diminutive sky-blue forget-me-nots found on high mountains to the majestic Plains cottonwood through its seasons. Each pastel is scientifically accurate and exquisitely artistic. Although she doesn't count black and white illustrations, she has produced countless pen and ink drawings, many using a stipple technique. These have ap-



16 Carolyn Crawford at work at Denver Botanic Gardens.



Sorbus scopulina

Greene's Ash, *Sorbus scopulina*, by Carolyn Crawford.

peared in *The Green Thumb* magazine, *Green Thumb News*, in other horticultural publications and include the logo with alpine columbine, *Aquilegia saximontana*, for the Rocky Mountain chapter of the American Rock Garden Society (RMC/ARGS).

Shortly after the Crawford family was settled in its south suburban home in 1981, Carolyn visited Denver Botanic Gardens intent on joining the Mycological Society. She had always enjoyed piney woods and its understory of ferns and mushrooms. Her interest in taxonomy and horticulture had been awakened during the family's residency in Houston.

She talks enthusiastically about being diverted to the Rock/Alpine Garden where little jewel-like blossoms reached out and "grabbed" her.

Of her work she says, "Rarely are my works anything that have a large physical presence on a wall from more than six feet away. I consider myself a spokesman for small plants; and my work, like the plants I paint, are best appreciated up close."

"The plants which speak to me most eloquently are those whose parts appear very insignificant to the naked eye, but glorious when observed under 10 to 20 power magnification; parts such as a

maple flower, the anthers of a male cottonwood catkin, a birch seed, a blue flax stamen or the interior of a loosestrife or speedwell flower. I remember well the best experience of all: studying the inside of the flower of Rocky Mountain kin-nikinnik. The incredibly beautiful, red sparkling anthers appeared covered with minute rubies under my lens as I dissected the flower. Yet most people never get to see something this sublime . . .”

Born in Minneapolis, she was eight years old when her mother enrolled her in her first art class in Enid, Oklahoma. There, several years later, she was graduated with a Bachelor of Fine Arts from Phillips University. For a time she was a high school art teacher, then a fluorographic fashion illustrator in Oklahoma City.

Pastel pencil combined with graphite calligraphy is her favorite medium. Devil's-claw, including those domesticated by American Indians for food, fascinate her. Mushrooms, veronicas and mostly wildlings are also intriguing. She is “not into cultivated plants except tropicals, especially orchids, bromeliads and cacti.” She has created nine trophy illustrations for the Denver Orchid Society. Recently she has expanded her artistic studies to portray various stages of insects such as *Cecropia* moth, milkweed beetle, the sphinx moth and the chrysalis of the Monarch butterfly.

One of Carolyn's most prestigious honors was the Grenfell Silver Medal awarded by the Royal Horticultural Society's Westminster Show in London in January 1988. For this exhibit she entered seven pieces of work representing Rocky Mountain wildflowers, including her current State of Colorado commissions on endangered flora. In 1983 and again in 1988, two of her pastels were acquired by the Hunt Institute for Botanical Documentation at Carnegie Mellon

University in Pittsburgh for inclusion in its permanent collection, considered the world's largest and most comprehensive of the work of 20th century botanical illustrators. The first, American Persimmon tree, *Diospyros virginiana*, in memory of T. Paul Maslin, Professor Emeritus of Zoology at the University of Colorado and a charter member of RMC/ARGS; and the second, Greene's Mountain Ash, *Sorbus scopulina*, in memory of Laura Louise “Timmy” Foster, long-time editor of the American Rock Garden Society bulletin.

Noteworthy among Carolyn's past exhibitions were a 1982 one-person showing of more than 60 botanical renderings at DBG followed in 1983 with another solo exhibition at San Francisco's Strybing Arboretum Society. Her *Lycaste skinneri "alba"* — the National Flower of Guatemala was the winning entry in the 1986 DBG Plant Sale poster competition. Printed and published by Jannes Art Publishing of Chicago, it is available at DBG's gift shop.

Carolyn Crawford's greatest dream, for the present at least, is to hold in her hands *Rare Plants of Colorado*, published by the Colorado Native Plant Society and scheduled for delivery in mid-June. Her *Penstemon grahamii* will grace its front cover; the centerspread will be a collage of color renderings of endangered flora.

Carolyn completes 25 to 30 paintings per year, mainly by commission. Her work is currently on view at Driscoll Gallery in Denver and at Montgomery House in Boulder.

— Bernice E. Petersen

Bernice Peterson is a long-time member of the Editorial Committee of the Denver Botanic Gardens and a frequent contributor to *The Green Thumb*. This is one of several articles she has written on botanical illustrators.

The Center for Plant Conservation: Saving the Future

by Carol Dawson

In the next 10 years about 680 plant species native to the United States will probably become extinct. This is three times more than the total number lost in the previous two centuries. Since 1987, the Denver Botanic Gardens has been an active participant in a nationwide effort to conserve at least some of these endangered plants. DBG is one of 19 botanic gardens and arboreta comprising the Center for Plant Conservation. The Center is a private non-profit organization dedicated to conserving rare and endangered native plants of the United States through cultivation and research. Each garden selects individual species for study based on input from other botanists working in the state. Efforts of the individual gardens are coordinated by the National Office in Jamaica Plain, Massachusetts.

For the past three years, we have concentrated on the preservation of Colorado endemic species, many of which occur in the sparsely vegetated shale barrens in the western part of the state. In order to find these populations, information concerning their location and growth season is obtained from the Colorado Natural Areas Program, the Nature Conservancy and the U.S. Fish and Wildlife Service. Once a proposed species has been iden-

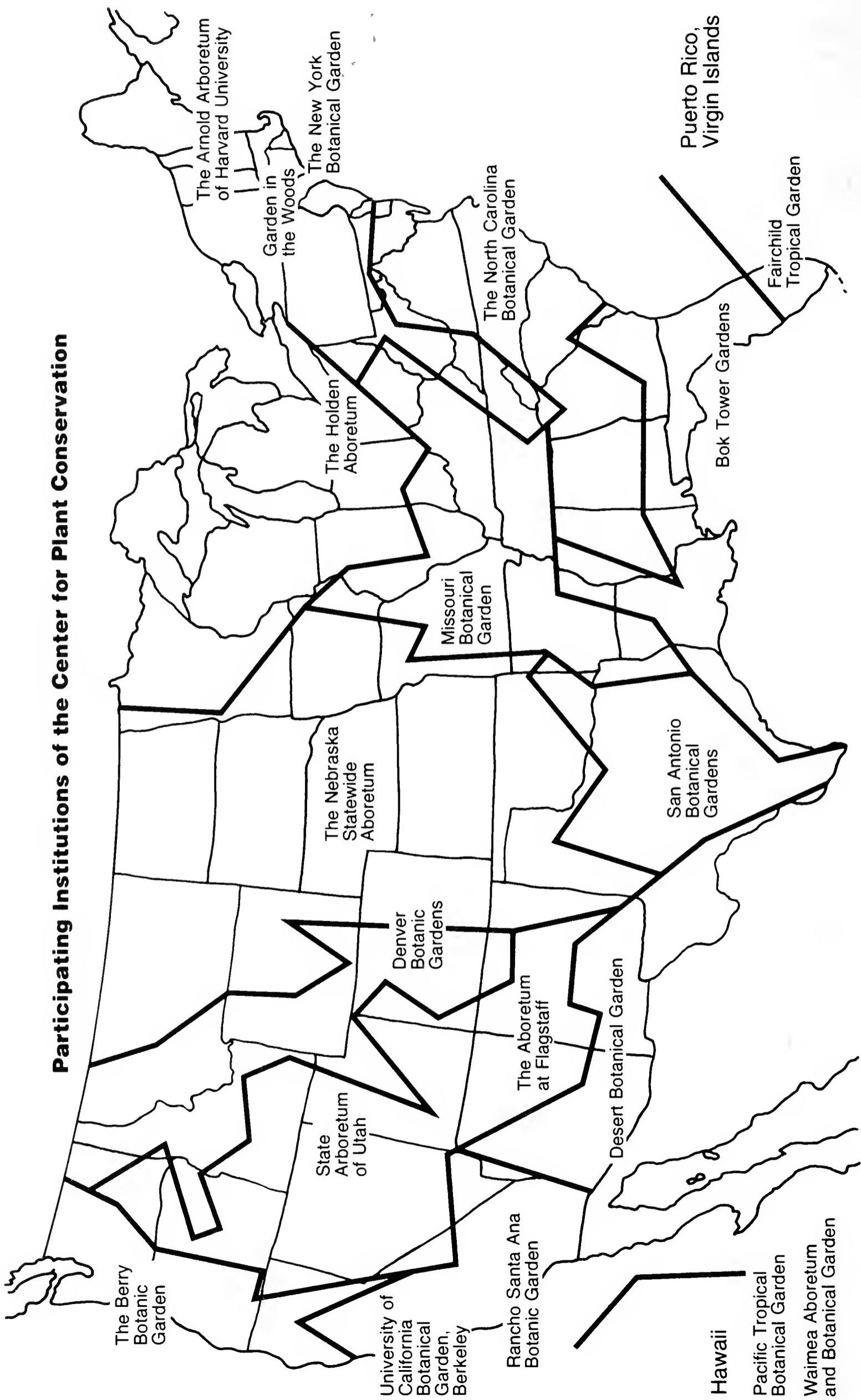
tified and located, seeds are collected in the wild. Several populations of each species are sampled to ensure that the living collections represent the genetic variability found in the wild populations. The bulk of the collected seeds are then placed in USDA seed storage facilities throughout the country. Collected seeds are also propagated here at DBG for studies on the life history of these rare taxa. This information will be used by habitat managers working with the wild populations. A long-term goal of the program is to have the National Collection serve as a backup in case these species actually become extinct in their natural habitats. Ultimately, plants raised in gardens may be reintroduced into restored habitats.

Plants grown from seed collected in 1987 are now on view in the Xeriscape Demonstration Garden here at DBG. This garden exhibits the various natural settings from which many dryland plants come. During the last week of March, the Dudley Bluffs bladderpod (*Lesquerella congesta*) began to flower. This little mustard is only 1 inch high, a round ball of yellow flowers covering grayish leaves. Soon another Piceance Basin endemic, *Physaria obcordata* (Dudley Bluffs twin-pod) will be showing yellow flowers.

Later this summer, species grown from seed collected in 1988 will be placed out in the garden. Seeds of the Penland beardtongue (*Penstemon penlandii*) were collected last year from the selenium-rich

Carol Dawson is Research Associate with the Center for Plant Conservation program at Denver Botanic Gardens.

Participating Institutions of the Center for Plant Conservation



badlands of Middle Park, Colorado. First discovered in 1986, this attractive pen-stemon has bicolored flowers, with blue lobes and a violet throat, making it an attractive candidate for horticultural use.

We have added twenty species to the National Collection of Endangered Plants from both Colorado and Utah. During the 1989 field season, we plan to collect seeds from several species found on the Ute Mountain Ute tribal lands. Of particular interest will be *Sclerocactus mesae-verde*, the Mesa Verde cactus, a species threatened by commercial cactus collectors.

This year we will also have the opportunity to work with the Nature Conservancy. We will be growing the seeds of *Aletes humilis*, or Larimer parsley, at DBG. The seeds will be collected from populations on the Nature Conservancy's Phantom Canyon Ranch. The plants at Phantom Canyon occur on rims above the canyon and on the steep canyon walls, forming mats of bright green, sharp-toothed leaves. These plants will be

placed on display at the new nature center being built by the Nature Conservancy at Phantom Canyon.

Plans to create an endangered species garden here at the Gardens are also under consideration. Visitors could enjoy seeing some of the rarest Colorado species as well as learning about their habitats and requirements.

With each year of participation in this program, we want to contribute our knowledge of the species' life history and cultivation requirements to others working in the field. In time, some of these plants may also be available to the public through the PEIP, or Plant Evaluation and Introduction Program. But for now, plan to walk through the xeriscape and enjoy some of Colorado's rare natives!

Funding for the CPC comes from foundation grants and private contributions. If you would like to help support the program at DBG, contact Nancy Brittain in the Development Office (331-4000) to make a gift designated for the CPC.

EXOTICS OF COLORADO

Smooth Brome, *Bromus inermis* Leyss

by Helen Marsh Zeiner

Bromus inermis Leyss., smooth brome, is a handsome grass frequently seen along roadsides in almost any part of Colorado from the prairies to the sub-alpine. It is so common that most people assume it is a native grass. It is, however, a European grass brought to this country to be used as a pasture and forage grass. It readily escapes from cultivation and is naturalized in many places.

Bromus inermis is an easily recognizable grass. The culms (jointed stems of grasses) arise from creeping rhizomes; they are erect and usually from 20 to 40 inches tall. Each culm terminates in an upright oblong panicle, greenish to purplish or reddish tinged, often brownish or bronze-colored at maturity. The panicle branches are whorled, spreading in flower but contracted at maturity. The panicles vary from about 4 inches to 8 inches long.

The spikelets (the units of the grass inflorescence which comprise the panicle) are about $\frac{3}{4}$ to 1 inch long, narrow, rounded, and 5 to 10 flowered.

Each spikelet has a pair of bracts or glumes at the base. Above these are the florets composed of another bract, the lemma, important in identification; a

second bract, the palea; and a much reduced flower. The panicle takes its color from the color of the lemmas. In *Bromus inermis* the lemmas are usually awnless, but a minute awn no more than $\frac{1}{8}$ inch in length is sometimes present. With few exceptions, all parts of the spikelet are smooth or glabrous.

The leaf blades are thin and relatively wide, mostly about $\frac{1}{2}$ inch wide. The blades and leaf sheaths are usually glabrous. This, together with the glabrous spikelet, gives the plant its name "smooth brome."

This useful grass is often planted as a forage grass or as a soil binder along road banks and shoulders and in other disturbed areas. In Colorado the Forest Service has used *Bromus inermis* along the shoulders of Forest Service roads. It is also used in reseeding western mountain ranges. Its strongly creeping rhizomes make it very successful for these purposes. It has good drought resistance and can be used in semi-arid regions. All in all, it has proved to be an exceptionally successful introduction.

Bromus inermis was introduced from Europe into the western United States in the 1890's as a cultivated hay and pasture grass, especially from Minnesota and Kansas to eastern Oregon and Washington, occasionally eastward to Michigan and Ohio. Some of the early seed imports were from Hungary, so the grass is sometimes called Hungarian brome.

The first seeds were imported, but later

Helen Marsh Zeiner, Ph.D., honorary curator of the Kathryn Kalmbach Herbarium at Denver Botanic Gardens, writes "Exotics of Colorado" as a regular feature of *The Green Thumb*.



Smooth Broom, *Bromus inermis*.

seeds for commercial use were derived from plants growing in old fields where they were well established and proven successful. One such variety came from old fields tracing back to original plants in 1895 by the Achenbach brothers of Washington County, Kansas, and released in 1944 by the Kansas Agricultural Experiment Station. Another Kansas variety came from the old fields in southern Lyon County, Kansas, where the grass was first grown in the mid 1890's on the Henry Jeanerette farm.

Seed from an 1884 Hungarian introduction into California was grown near Lincoln, Nebraska, before 1898. Commercial seed was later derived from these old Nebraska fields. Still other seeds came from original plantings on South Dakota farms, made in 1905-1915. An old field established in 1917 on the E.A.

Fischer farm near Shenandoah, Iowa, also provided seeds.

It is interesting to note that one variety was developed at Montrose, Colorado, by Clarence Sandburg from plants selected by Douglas Lytle of Montrose between 1925 and 1933.

Many early varieties have been replaced by newer varieties, but others may still be available.

References

- Cronquist, Arthur, Arthur H. Holmgren, Noel H. Holmgren, James L. Reveal, Patricia K. Holmgren. 1977. *Intermountain Flora*, Volume 6. New York: Columbia University Press.
- Hanson, A.A. 1959. *Grass Varieties in the United States*. Washington, D.C.: United States Government Printing Office.
- Harrington, H.D. 1946. *Grasses of Colorado*. Fort Collins, Colorado: Colorado A & M College.
- Hitchcock, A.S. 1935. *Manual of the Grasses of the United States*. Washington, D.C.: United States Government Printing Office.

Attracting Butterflies to the Eastern Colorado Garden

by Paul A. Opler and Whitney S. Cranshaw

Butterflies are among the most interesting creatures in your garden. If you stalk them as carefully as you would any wildlife, you can see territorial battles, frenzied courtship, breathtaking escapes from predators and careful exploration for hostplants. If you prefer to sit back in a garden chair, you will see your garden come alive, the flowers seeming to take flight and drift on the wind. All this is available in your own garden if you make it hospitable to the butterflies that occur commonly along the Front Range and in eastern Colorado.

Planning the Butterfly Garden

An area can be made more attractive to butterflies if it can provide the proper environment sought by the insects. Most important are: food plants used by the immature stages (various caterpillars), food sources used by the adult butterflies and physical environment.

Most butterflies prefer some shelter from high winds common along the Front Range as well as open sunny areas. Windbreaks can help provide a suitable physical environment.

Certain kinds of butterflies (mostly males) can often be seen feeding on moist

sand or mud. The function of these "mud puddle clubs" is not fully understood but it is thought that the water contains dissolved minerals needed by the insects. Maintaining a damp, slightly salty area in the yard may attract groups of these butterflies.

Adult female butterflies spend time searching for food plants required by the immature caterpillar stage. Most butterflies have specific host plants on which they develop. For example, caterpillars of



Western Tiger Swallowtail, *Papilio rutulus*.

Paul A. Opler is Leader, Editorial Section, Office of Information Transfer, USDI-FWS; Whitney S. Cranshaw is assistant professor of entomology at Colorado State University. This article is adapted from CSU Extension Bulletin No. 5.504.



Large Marble White, *Euchloe ausonides*.

the Monarch butterfly only develop on milkweed while the black swallowtail feeds only on parsley, dill and closely related plants. When females find the proper host plant, they may lay eggs on it.

Providing the necessary food plants for the developing caterpillars also allows production of a "native" population that can be observed in all stages of development. Most species, however, will fly away as adult butterflies.

Food for adult butterflies usually consists of sweet liquids that provide needed energy sources, such as nectar from flowers. Some flowers contain more nectar thereby increasing their attractiveness to butterflies. Often, specific types of flowers and flower colors are more attractive to butterflies. Honeydew (produced by aphids), plant sap, rotting fruit, and even bird dung are fed upon by some species.

When planning a garden it is most effective to create large patches of single flower species to attract and retain butterflies. Consideration also should be given to flowers that bloom in sequence. This is particularly important during summer when flower visiting by butterflies is most frequent. Flowers and flowering shrubs that might be good choices for an eastern Colorado butterfly garden are included in Table 1.

Common Conflicts

Many of the most attractive nectar plants are commonly considered as "weeds" in other settings. Good examples of these are various thistles and dandelion, all highly attractive to several common butterflies. The well-manicured and tended garden will discourage some butterfly species which develop on wild plants. (Note: Canada thistle is considered a

Table 1. Ten flowering plants useful for attracting butterflies in eastern Colorado. Scientific names are given at the first occurrence of the common name in the tables below.

Asters	Lilac
Butterfly bush (<i>Buddleia davidii</i>)	(<i>Syringa vulgaris</i>)
Butterfly plant (<i>Asclepias tuberosa</i>)	Marigold (<i>Tagetes spp.</i>)
Bush cinquefolia (<i>Potentilla fruticosa</i>)	Rabbitbrush (<i>Chrysothamnus nauseosus</i>)
Cosmos (<i>Cosmos spp.</i>)	Verbena (<i>Verbena spp.</i>)
	Zinnias



Monarch, *Danaus plexippus*.

noxious weed. Areas of the state that have formed weed districts prohibit by law the culture of Canada thistle.)

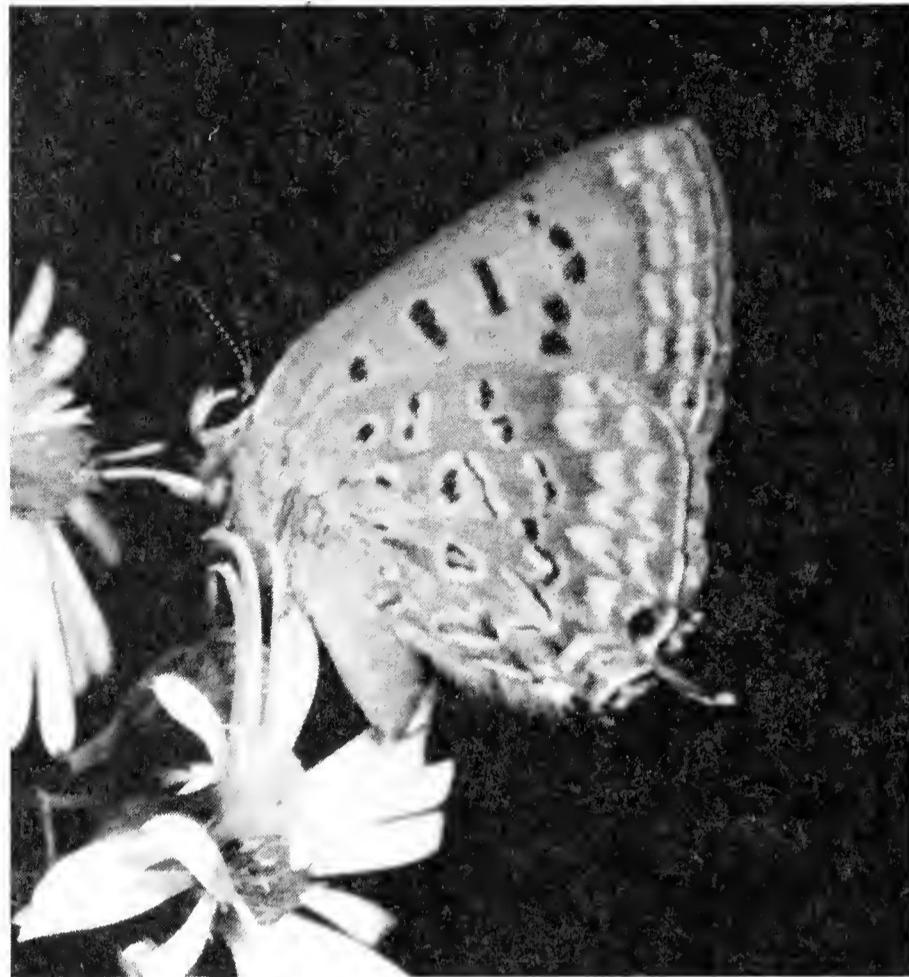
A few of the butterflies also develop on certain garden crops and may be pests if the vegetable is considered more desirable than the insects. The cabbage but-

terfly and the black swallowtail are common garden inhabitants in Colorado.

Insecticides should be used sparingly because most are not compatible with the goal of attracting and increasing the number of butterflies in a yard. Most garden insecticides can kill the caterpillar

Table 2. Food used by common eastern Colorado butterflies and skippers.

Butterfly	Flight period	Caterpillar food	Common nectar plants, adult food
Two-tailed swallowtail (<i>Papilio multicaudatus</i>)	Apr-Aug	Green ash, choke-cherry	Geranium (<i>Geranium spp.</i>), thistle (<i>Cirsium spp.</i>), milkweed
Western tiger swallowtail (<i>Papilio rutulus</i>)	May-Jul	Willow, cottonwood, chokecherry	Zinnia, lilac, butterflybush, thistle, milkweed
Black swallowtail (<i>Papilio polyxenes</i>)	Apr-Sep	Dill, parsley, fennel, carrot	Butterflyweed (<i>Asclepias spp.</i>), alfalfa, thistle
Monarch (<i>Danaus plexippus</i>)	Jun-Oct	Milkweed (<i>Asclepias spp.</i>)	Cosmos, rabbitbrush, etc.
Weidemeyer's Admiral (<i>Limenitis weidemeyerii</i>)	Jun-Sep	Willow, aspen, cottonwood	Sap flows, snowberry (<i>Symporicarpos oreophilus</i>), dung
Hackberry butterfly (<i>Asterocampa celtis</i>)	May-Sep	Hackberry	Rotting fruit, sap flows
Painted Lady (<i>Vanessa cardui</i>)	Apr-Oct	Thistle, hollyhock, sunflower	Grape hyacinth, cosmos, zinnia, alfalfa, many flowers
European cabbage butterfly (<i>Pieris rapae</i>)	Apr-Oct	Broccoli, cabbage (mustard family)	Many
Checkered white (<i>Pontia protodice</i>)	Apr-Nov	Tumble mustard (<i>Sisymbrium altissimum</i>)	Alfalfa, mustards, beeplant (<i>Cleome spp.</i>)
Clouded sulfur (<i>Colias philodice</i>)	Apr-Nov	Alfalfa, clover	Alfalfa, phlox, rabbitbrush, aster, marigold
Orange sulfur (<i>Colias eurytheme</i>)	Apr-Oct	Alfalfa, vetch, pea	Alfalfa, marigold, zinnia
Melissa blue (<i>Lycaeides melissa</i>)	Apr-Oct	Wild liquorice (<i>Glycyrrhiza lepidota</i>), alfalfa, etc.	Beeplant, sweet clover (<i>Melilotus spp.</i>)
Grey hairstreak (<i>Strymon melinus</i>)	May-Oct	Many	Many
Variegated fritillary (<i>Euptoieta claudia</i>)	Apr-Oct	Various, incl. pansy	Rabbitbrush, Canada thistle (<i>Cirsium arvense</i>)
Edwards fritillary (<i>Speyeria edwardsii</i>)	Jun-Sep	Nuttall's violet (<i>Viola nutallii</i>)	Rabbitbrush, Blanket flower (<i>Gaillardia</i>), beeplant
Gorgone checkerspot (<i>Charidryas gorgone</i>)	May-Sep	Sunflowers	White clover, dandelion, Canada thistle
Mourning cloak (<i>Nymphalis antiopa</i>)	Feb-Nov	Willow, aspen, cottonwood, elm	Rabbitbrush, mildweed, sap
Wood nymph (<i>Cercyonis pegala</i>)	Jun-Aug	Grasses	Rabbitbrush, clematis, Canada thistle
Silver-spotted skipper (<i>Epargyreus clarus</i>)	May-Jul	Wild liquorice, locust, etc.	Lilac, dogbane, zinnia, sweet pea, Canada thistle
Checkered skipper (<i>Pyrgus communis</i>)	Apr-Oct	Mallow (<i>Malva spp.</i>), hollyhock	Verbena, dandelion, Canada thistle, aster



Tailed Copper, *Tharsalea arota*.

stages of the insects. Adult butterflies can also be killed by resting on insecticide-treated surfaces.

Don't be concerned that attracting birds to your garden will endanger your butterflies. Many butterflies are distasteful and are warningly colored, or mimic ones that are; birds ignore them. Other butterflies have coloring and behaviors that make them inconspicuous. Predatory insects and other forms of biocontrol will not seriously affect butterfly populations. Most butterflies are kept in check by their own specific natural enemies.

Begin by trying masses of some of the nectar plants listed here. If even this

seems too ambitious, put a big pot of *Lantana* from your local garden center in a sunny spot near a window. The life the passing butterflies bring to your garden will soon have you trying for more.

References

- Ferris, C.D. and F. M. Brown. 1980. *Butterflies of the Rocky Mountain States*. Norman: University of Oklahoma Press.
- Pyle, R.M. 1981. *Audubon Field Guide to North American Butterflies*. New York: Alfred A. Knopf.
- Tekulsky, M. 1985. *The Butterfly Garden*. Boston: Harvard University Press.
- Tilden, J.W. and A. Smith. 1985. *Field Guide to the Butterflies of Western North America*. Boston: Houghton-Mifflin.

Watching Butterflies

by Alcinda A. Cundiff

As a biologist, I know that flowers evolved for one reason only: to allow plants to exchange genes with other plants of the same species. As a gardener, I know that flowers seem to have evolved solely to give me intense pleasure. We'll probably never know why flowers evoke such strong feelings in humans but we can learn more about their effects on various non-human animals that find them irresistible. I've been studying these effects for the last few years, using techniques which are available to anyone with access to flowers and butterflies. I discovered that butterflies learn how to extract nectar from flowers, a surprising result with far-reaching implications.

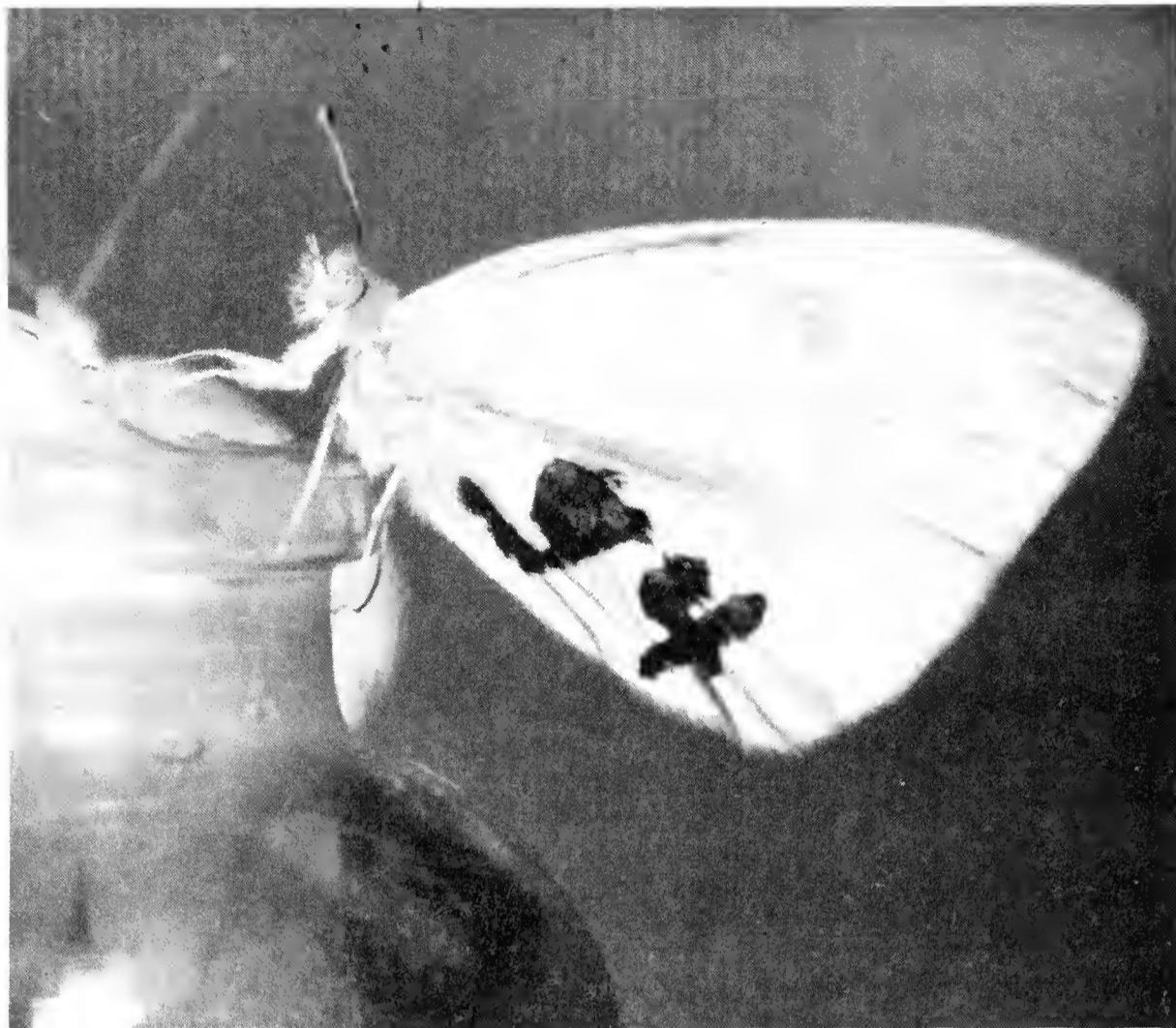
Learning and Forgetting

My first discoveries were made, as they often are in science, purely by accident. I was working with British biologist and wildflower grower Miriam Rothschild on her estate in Northamptonshire. We were studying the egg-laying behavior of the cabbage white butterfly, *Pieris brassicae*. To obtain butterflies for my experiments, I made a trade with an entomologist who raised large numbers in his greenhouse. I gave him a bottle of Rothschild wine and he gave me a box full of pupae, the resting stage between caterpillar and adult butterfly.

Alcinda A. Cundiff is a Research Associate in Biology at the University of Colorado and Editor of *The Green Thumb*.

When the butterflies came out of the pupae, I had to keep them alive by giving them nectar or a sugary substitute. The Head Gardener would not let me use the wildflowers he was raising for a hoped-for gold medal at the Royal Horticultural Society's Chelsea Show. I had to use artificial flowers, devised by my butterfly supplier. These bore little resemblance to real flowers, consisting of a wooden platform containing glass wells of sugar water. The platform was green, and surrounding each well were four crudely painted yellow petals. As I fed the butterflies each day, I noticed that they seemed to get better at recognizing and using these artificial flowers. This was quite surprising because it meant that the butterflies were learning. Although learning in honey bees is well known, scientists assumed that bees are animals of unusual intelligence and that a lowly butterfly, especially one that lives only two weeks as an adult, couldn't learn.

Why should an insect visiting a flower for nectar need to learn anything? The answer lies in the advantage to the flower of sexual reproduction. Flowers continually try out new genetic combinations — slight variations on a theme. Environments are constantly changing so a plant can hedge its bets by producing several offspring differing in their ability to meet new challenges. Producing these diverse offspring means getting pollen from one plant to another. This can be done by releasing it to the wind and hoping for the



Numbered cabbage white butterfly on vial of sugar water.

best, a system so flawed that it was jettisoned at the evolution of the angiosperms from the gymnosperms. Alternatively, the flower can pay an animal, by giving it pollen or nectar, to take pollen to another flower of the same species. The pollen must not be wasted on the wrong species. Flowers help ensure pollinator fidelity by being distinctive in pattern, shape and scent. They also often make the reward difficult to find and extract. Therefore, once an insect has figured out how to extract the reward, it should remember the flower and the correct extraction technique, and stick with that species. Being faithful to one species means the insect saves valuable time while flower hunting.

Testing the Hypothesis

Darwin was the first to suggest that the need to learn extraction techniques explains the puzzling flower fidelity of many insects: "they have just learned how to stand in the best position on the flower and how far and in what direction to insert their proboscides." I provided

the first test of his hypothesis. I used *Pieris rapae*, the cabbage white butterfly, and worked in the field and greenhouses at the former Cary Arboretum of the New York Botanic Gardens, now the Institute of Ecosystem Studies. Other experiments were done in greenhouses at the University of Colorado.

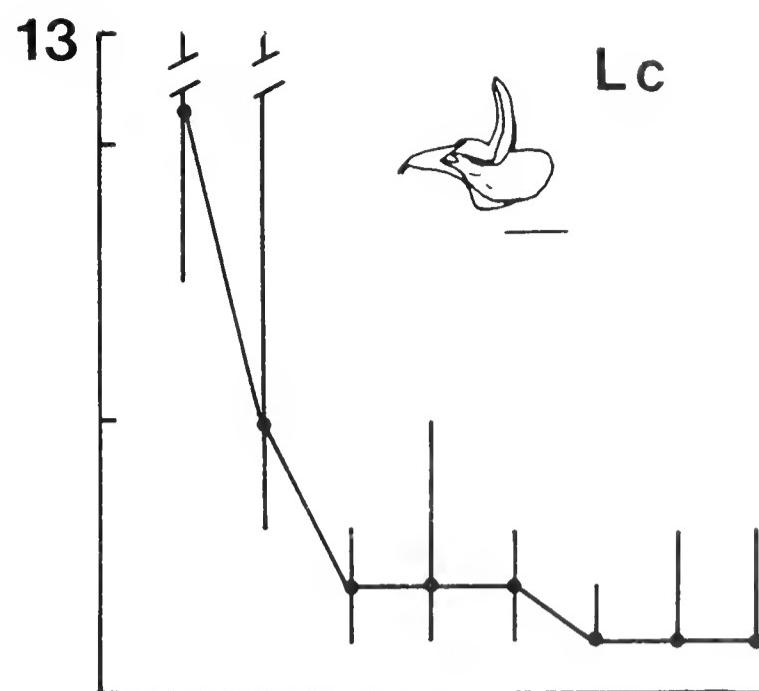
To test Darwin's hypothesis, I needed to do three things. First, I had to determine if butterflies, like bees, are indeed faithful in their visits to flowers of one species. Opinions in the literature differed greatly and no quantitative test had been made. By following butterflies through flower-filled meadows, I found that they can be quite faithful to one species, as long as the flower is rewarding enough and they are not interrupted by mating, fighting or egg-laying. Honey bee workers are not as easily distracted, having only one goal: they are more faithful flower visitors than butterflies. In another experiment, I gave caged butterflies one species for 24 hours. I then gave them a choice between that species and two others. Butterflies almost always

chose the flower with which they had experience, revealing both flower fidelity and an ability to learn to recognize rewarding flowers.

Second, I had to show that butterflies learned how to extract nectar from flowers. This I did by giving flowers to newly-emerged, caged butterflies. When butterflies first land on a flower, they can't find the nectar. They search all the flower parts with their tongues until they finally contact nectar. But the next time they land on the flower, they find the nectar more quickly. They continue to improve in their performance, their times following a classic learning curve. Flowers with simple morphology are learned more quickly than ones with complex morphology, but almost all flowers must be learned.

If butterflies could remember all species simultaneously, they wouldn't need to be faithful to just one species. They could visit every flower in their path, saving considerable travel costs. So for the third part of my test of Darwin's hypothesis, I needed to show that learning a second species makes the butterfly forget the first. I did this by giving some butterflies bellflower to learn, followed by trefoil. I then tested them on bellflower. I gave another group of butterflies, the controls, bellflower to learn but not trefoil; I also tested them on bellflower. Butterflies in the first group did have to re-learn bellflower; ones in the second group did not.

These results mean that it is advantageous to stick with one species once it has been learned: if you switch, you forget the first species. (This happens in people, too. Try this experiment. Have a friend give you a few phone numbers off a page in the phone book. Learn one number, then time how long it takes you to find that number on the page. Then memorize a few more numbers and compare your time to find the numbers.) These results also suggest that flowers are in a sense taking advantage of the limited memories of their animal visitors: flower



Learning curve on *Lotus corniculatus*, trefoil: time required in seconds for 15 butterflies to discover nectar in 8 attempts; values are medians and quartiles.

morphology is ultimately related to the brain capacity of animals.

Since it only takes a butterfly a few minutes to learn a flower, you would be justified in being skeptical of the importance of this result. But Bernd Heinrich, working with bumble bees, showed a significant energetic cost to every minute of foraging by a short-lived insect. Another cost of spending time on a flower may be higher: predatory bugs and spiders sit on flowers, waiting for hapless victims to land. The longer a butterfly spends on a flower, the more likely it will be attacked.

You would also be justified in being skeptical of the larger importance of this work. Defending basic research is always difficult, but the same reason given for similar projects on other organisms applies here: if we understand the processes of evolution and of learning, we will be better equipped to use the knowledge for our benefit.

Butterfly Watching for Gardeners

I obviously find watching butterflies gripping enough to put in long hours of labor in hot fields and greenhouses and equally long hours writing the grant proposals and papers that support the work. I believe this strong interestulti-

mately comes from the survival value that animal (and plant) watching had during our evolutionary history. Whatever the reason, I'm sure that everyone could share my fascination, at least to some extent. All it takes is a little time and patience, and a lot of butterflies. You can increase the chances of seeing these interesting behaviors by encouraging butterflies in your garden. The article by Paul Opler and Whitney Cranshaw in this issue gives you some guidelines.

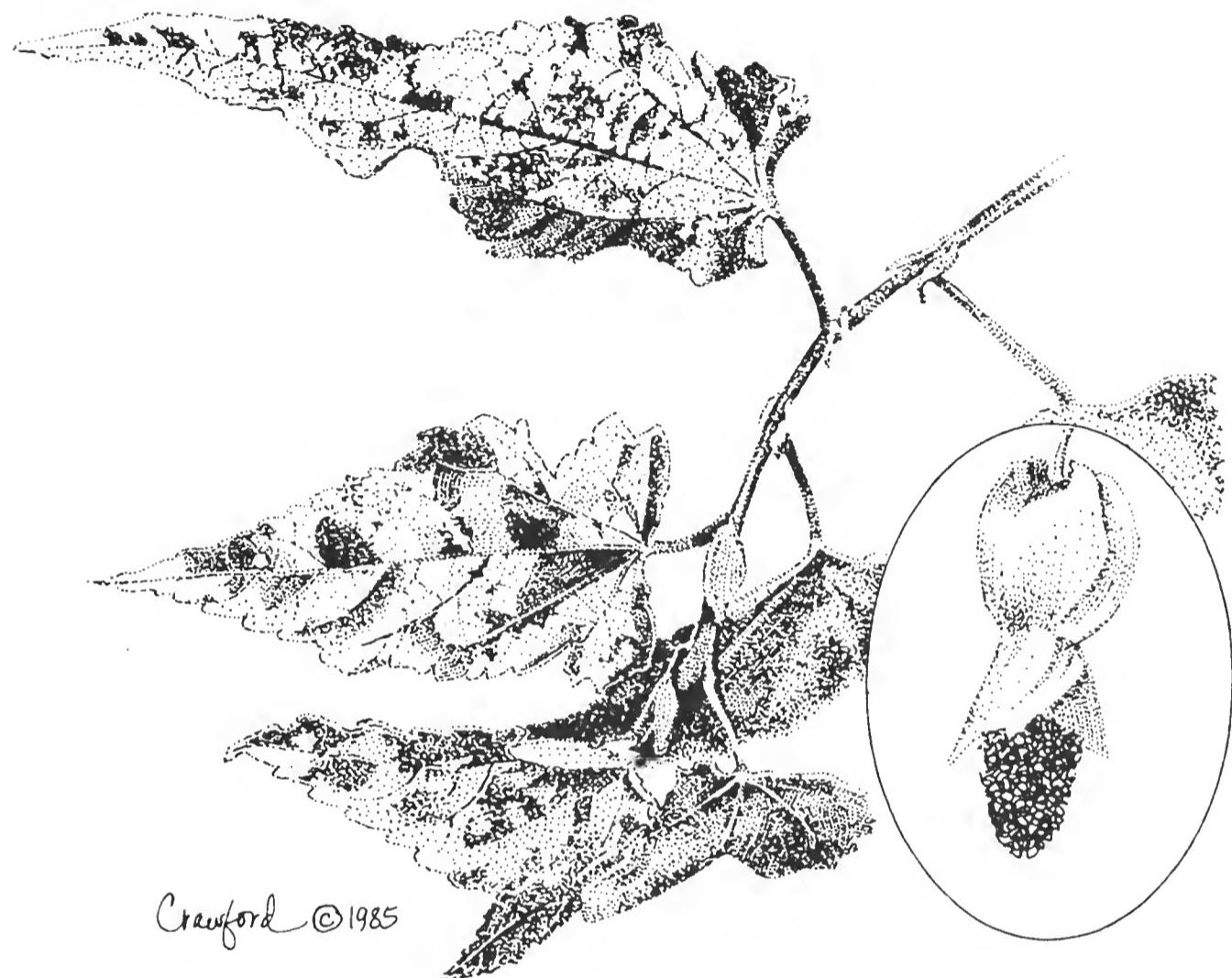
If you want to get a closer look at butterflies, consider buying or making an insect net. Catch butterflies by gently lowering the net over a feeding or resting butterfly. You can then reach inside the net and remove the butterfly. Hold butterflies by what you might call their shoulders. If you hold them with their wings closed, you can write a number on their wings with a laundry marker. You can then follow individuals, observing their flower and site fidelity. Numbered butterflies have contributed greatly to our understanding of population biology and gene flow.

If you want to raise your own butter-

flies, simply take a female (use a field-guide to determine the sex) and put her in a cage with nectar and larval hostplants. She will lay eggs which should produce adults in a few weeks, if you keep a fresh supply of hostplant available. Some species will go into a long diapause before emergence so don't despair; they may emerge from the pupae weeks or months later. Use the books in the reference section of the accompanying article on butterfly gardening for more information. Butterfly watching has many rewards at many levels. At the very least, it will add a new dimension to your gardening and possibly even introduce you to a whole range of obliging plants.

References

- Darwin, C. 1876. *The Effects of Cross- and Self-Fertilization in the Animal Kingdom*. London: Murray.
Lewis, A.C. 1986. Memory constraints and flower choice in *Pieris rapae*. *Science* 232:863-865.
Lewis, A.C. 1989. Flower visit consistency in *Pieris rapae*, the cabbage butterfly. *Journal of Animal Ecology* 58:1-18.
Lewis, A.C. 1990. Learning and flower use in butterflies: hypotheses from honey bees. *Focus on Plant-Insect Interactions*. In press.



Flowering maple, *Abutilon megapotamicum* 'Variegata' by Carolyn Crawford.

Illustration Sources

Front cover: Art by Frances Frakes Hansen
p. 5: Map courtesy Denver Public Library,
Western History Department from original
in Colorado State Historical Society Library
pp. 6-7, 10-11, 16-17: Photos by Deane Hall
p. 12: Plan by Karen Grote, Denver
Department of Parks and Recreation
pp. 13-14, 17: Art by Carolyn Crawford

p. 20: Map courtesy of the Center for Plant
Conservation
p. 23: Art by Doris Peacock
pp. 24-26, 28: Photos courtesy of Paul Opler
p. 30: Photo courtesy of Clive Jones
p. 31: Art by Alcinda Cundiff
Back cover: Art courtesy of Carolyn Crawford

The Green Thumb

Denver Botanic Gardens, Inc.

A Non-Profit Organization

Sent to all members of Denver Botanic Gardens. Membership fees are as follows: Student \$18, Individual Senior Citizen \$18, Senior Couple \$25, Individual \$25, Family/Dual \$35, Contributing \$50, Supporting \$100, Patron \$500, Benefactor \$1000.

By becoming a member of Denver Botanic Gardens, Inc., you will receive *The Green Thumb* and the monthly *Green Thumb News*. You will also have year-round admission to the gardens and unlimited access to the use of the books in the Helen K. Fowler Library, located in Boettcher Memorial Center at 1005 York Street.

For further information, write to Membership Chairman, Botanic Gardens House, 909 York Street, Denver, Colorado 80206, or call 331-4000.

Denver Botanic Gardens, Inc., maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing and spreading botanical and horticultural knowledge.

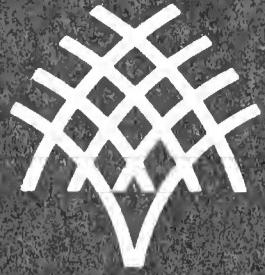
This is a non-profit organization supported by municipal and private funds.

Denver Botanic Gardens, Inc.
909 York Street
Denver, Colorado 80206

NON-PROFIT ORG.
U.S. POSTAGE PAID
Permit No. 205 Denver, Colorado



The Green Thumb



Autumn/Winter 1989

Volume Forty-six
Number Two



FFH

The Cover

Bonsai

Frances Frakes Hansen

Published by

Denver Botanic Gardens, Inc.
909 York Street
Denver, Colorado 80206

Alcinda A. Cundiff, *Editor*
Andrew Pierce, *Acting Executive Director*
Beatrice Taplin, *President*

Illustration Sources

Front Cover: Art by Frances Frakes Hansen
pp. 33-39: Line drawings, Schichtel Nursery Catalogue, courtesy of George Schichtel
pp. 34, 37, 39: Photos by James Feucht
pp. 40, 41, 43, 44, 59, 60: Photos by Deane Hall
pp. 45, 46, 48: Photos by Clayton Lewis
pp. 49, 50: Photos by Yan Linhart
p.53: Art from *The Gardener's Labyrinth*, 1651, Thomas Hyll; p. 52, 55, plants from *Commentaries on the Six Books of Dioscorides*, 1544, by P. Mattioli
p. 53 knots from *The Country Housewife's Garden*, 1617, Gervase Markham
p. 56: Drawing by Rob Proctor
pp. 54, 57: Photos collection of Denver Botanic Gardens Library
p. 63: Illustration courtesy of the Colorado Native Plant Society and the Rocky Mountain Nature Association
p.64: Photo by Loraine Yeatts

The Green Thumb

Autumn/Winter 1989

Volume Forty-six, Number Two

Contents

Ornamental Trees to Tailor for the Small Garden <i>Larry Watson</i>	33
Bonsai: An Interview with Harold Sasaki	40
Trees and Trout: A Colorado Forest in a Suburb <i>Alcinda Cundiff</i>	45
Forests of Colorado	49
Societies: Native Plants and Conservation	51
Herbs for You: Guidelines for the Rocky Mountain Gardener <i>Gloria Falkenberg</i>	52
The Waring Rare Book Room <i>Solange Gignac</i>	59
Rare Plants of Colorado <i>Velma Richards</i>	62
Thank you, Velma	64
Indices 1989	
cover	

Copyright 1989

by Denver Botanic Gardens, Inc.

ISSN 00431108

Ornamental Trees to Tailor for the Small Garden

by Larry Watson

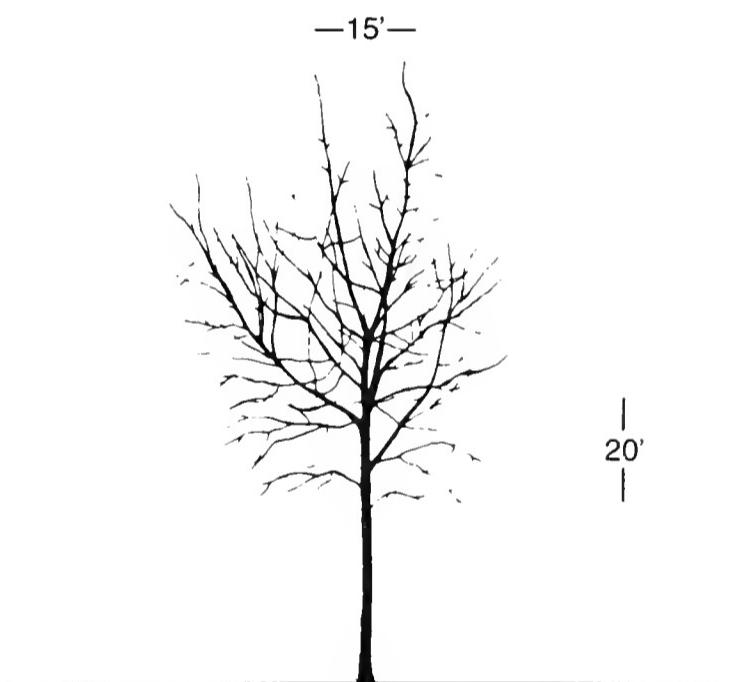
With the space available for planting around residences decreasing, smaller ornamental trees are in demand. The need for trees 20 to 40 feet in height has been filled most often in the Front Range with several varieties of crabapples and plums. Although these are tried and true trees, there are alternative species that are often overlooked. The more species we have in our landscape palette, the more interest and variety we have in our landscape.

Tartarian Maple—The Tartarian maple (*Acer tartaricum*) is a small tree with a rounded form, 20 to 30 feet in height and with a spread of 15 feet. Its natural form is shrub-like, so it will require selective pruning when young to make a single trunk tree. In growth characteristics and size, it is comparable to the more familiar Amur maple (*Acer ginnala*). The leaf of *A. tartarcium* is not as lobed as that of *A. ginnala* and the fall color is yellow, rather than red.

Larry Watson, graduate of Colorado State University, has been influential in introducing many native and exotic plants to Rocky Mountain residential and commercial landscapes. He is currently employed by Schichtel's Nursery and also conducts a private consulting business based in Denver. He was assisted in this article by Julia Andrews-Jones, landscape architect. We thank George V. Schichtel for kind permission to reproduce illustrations from the Schichtel Nursery catalogue.

Acer tartaricum

Form:	open rounded
Texture:	medium
Fruit:	winged red samaras
Fall:	yellow-orange



The advantage of *A. tartaricum* over *A. ginnala* is its higher tolerance of the alkaline soils common in the Front Range. It produces a very striking red samara (winged fruit) in mid-summer. The fruit is so vivid a color that the tree appears to be in flower.

This tree is listed as Zone 4, but in my experience it exhibits more hardiness than that classification would indicate. If *A. ginnala* turns yellow in the summer in your neighborhood or if your soil is known to be alkaline, this small tree could be a better choice.

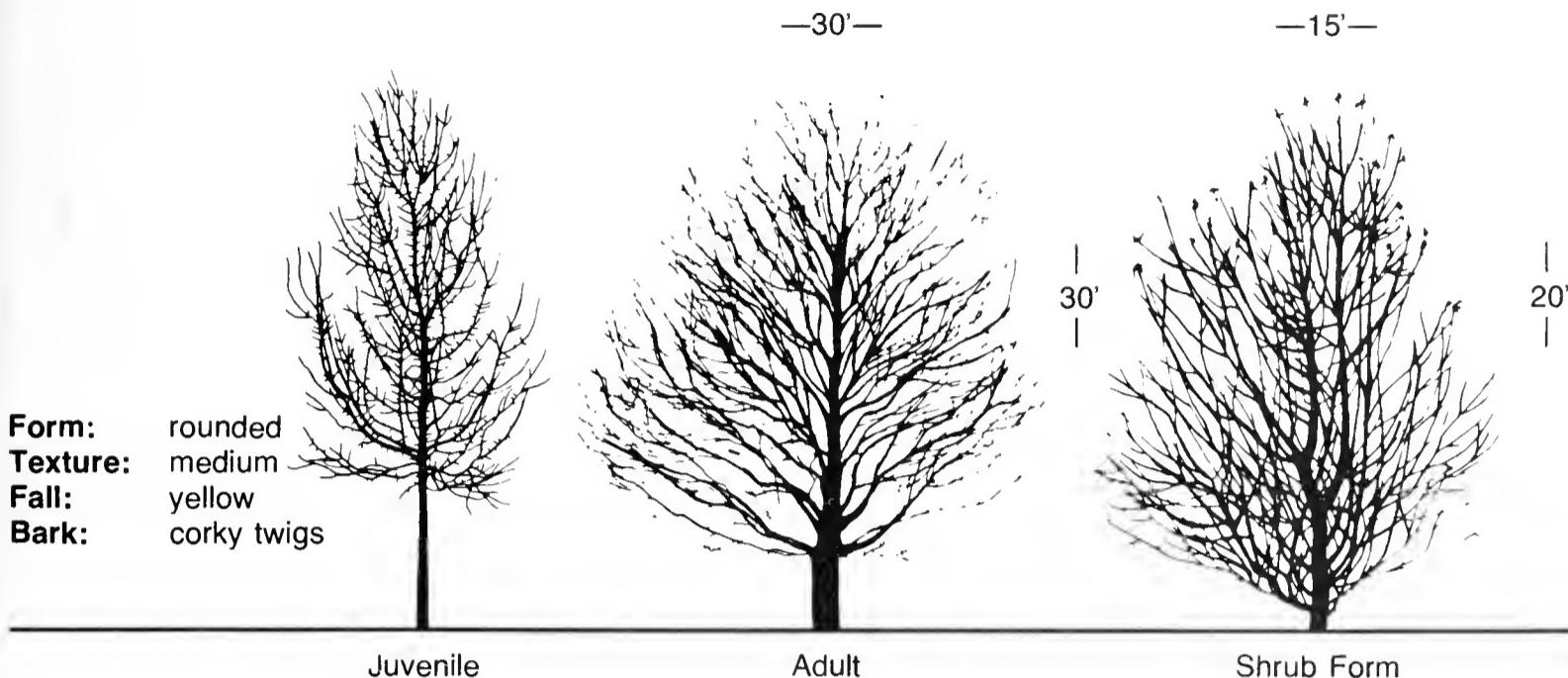


Acer tartaricum, foliage and fruit.

Hedge Maple—Another maple that is very tolerant of alkaline soils is *Acer campestre*. It grows with a very straight trunk to 30 to 40 feet, with well spaced branches. Other interesting characteristics of *A. campestre* are a corky bark, tolerance for relatively dry conditions and yellow fall color. Although this tree has not been used in the Front Range enough for total endorsement, I have observed it for 5-6 years and it appears to adapt well. It is listed as Zone 4 hardiness.

Wasatch Maple—Another maple that should not be overlooked as a small tree is the Wasatch maple, *Acer grandidentatum*. It is native to the alkaline soils of Wyoming, Utah, New Mexico and northern Mexico. It exhibits great tolerance to drier alkaline soils. This tree will reach a height of 25 to 35 feet with a spread of 15 to 20 feet. It can be grown either as a single stem or multi-stem tree. The Wasatch maple is a little slower growing than *A. ginnala* or *A. tartaricum*. This also makes it a stronger wooded tree and therefore less subject to breakage. It has a thick dark green leaf, similar to sugar maple, that turns orange-red in the fall.

Acer campestre

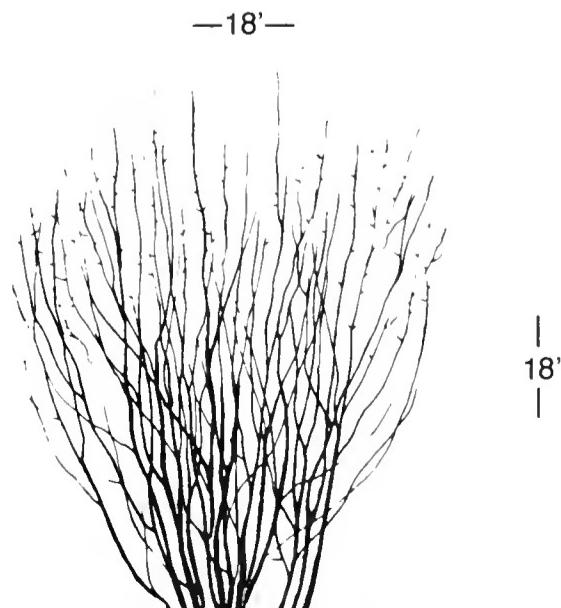


Serviceberry—Over the last few years in the nursery business, we have been testing several varieties of *Amelanchier*. Much to our happy surprise, they seem to do well in Colorado. They grow better in a less alkaline soil, though the native *A. alnifolia* is quite tolerant of alkaline soils and heavier clay. It is difficult to make *A. alnifolia* into a tree because it sends up many branches from the base of the plant. With proper pruning, however, it can be

formed into a multi-trunk tree. Some of the *Amelanchiers* grown in the eastern United States can be pruned into tree form more easily. The eastern forms may not be as drought tolerant, but would be compatible with our bluegrass lawns. My selection of varieties for this area would be *Amelanchier x hybrida* 'Cumulus' (plant patent 3092), *A. laevis* and *Amelanchier x 'Robin Hill'*.

Amelanchier alnifolia

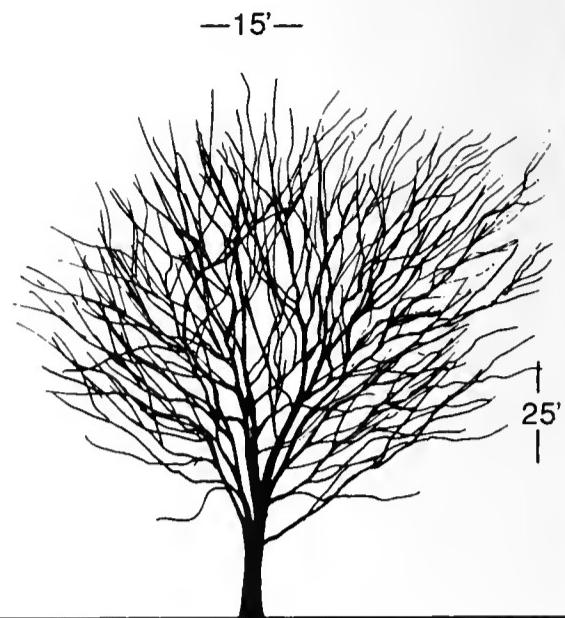
Form: rounded
Texture: medium fine
Fruit: large, blue-
berry-like



**Amelanchier x
hybrida 'Cumulus' pp #3092**

Amelanchier x hybrida 'Cumulus' will reach a height of 25 feet and the top will be 15 feet across. It makes a tree with little special pruning. The white flowers early in the spring are followed by small red fruit. In the fall the foliage will turn orange-yellow.

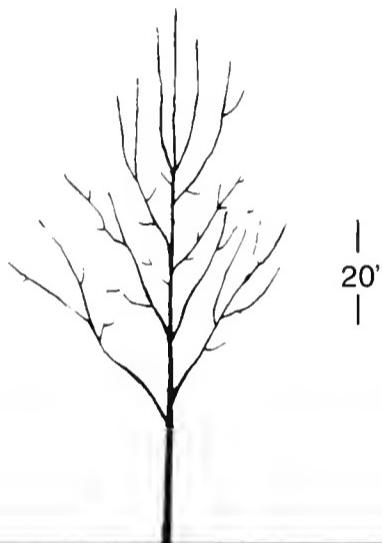
Form:	upright open
Texture:	medium-fine
Flower:	white, early
Fruit:	red, small
Bark:	smooth, grey
Fall:	orange-yellow



Amelanchier laevis

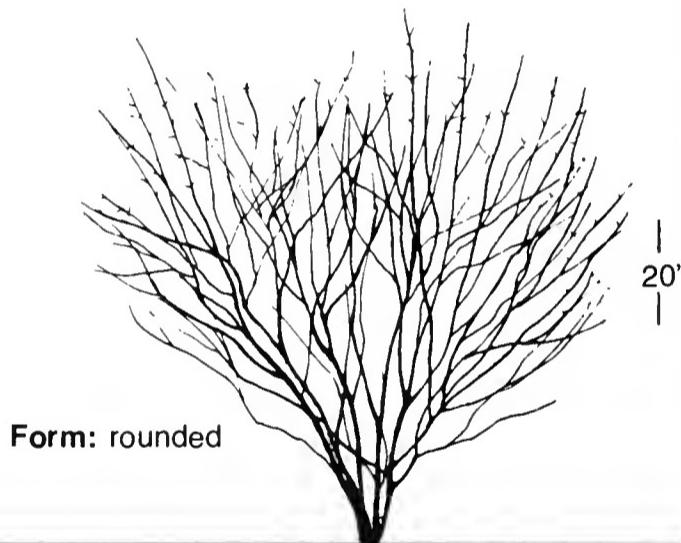
—20'

Form:	rounded
Texture:	medium-fine
Foliage:	new growth bronze
Fruit:	black, sweet
Fall:	yellow



Tree Form

—20'



Clump Form

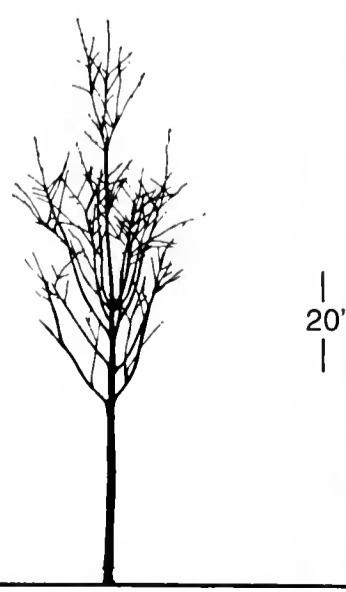
A. laevis (Allegheny serviceberry) will be 20 feet tall and 20 feet across with a rounded habit of growth. The new foliage will emerge with a bronze cast. Following the white flowers in the spring will be sweet black fruit. The fall color is yellow.

Amelanchier x 'Robin Hill' (Robin Hill pink serviceberry) is more upright in form. It will also reach 20 feet but will be 12 feet wide. It is naturally tailored for small spaces! The immature form is considerably more upright. *Amelanchier x 'Robin Hill'* has pale pink flowers followed by small red fruit. Its fall color ranges from yellow to red. Any of the *Amelanchiers* would be welcome additions to the Front Range.

**Amelanchier x
'Robin Hill'**

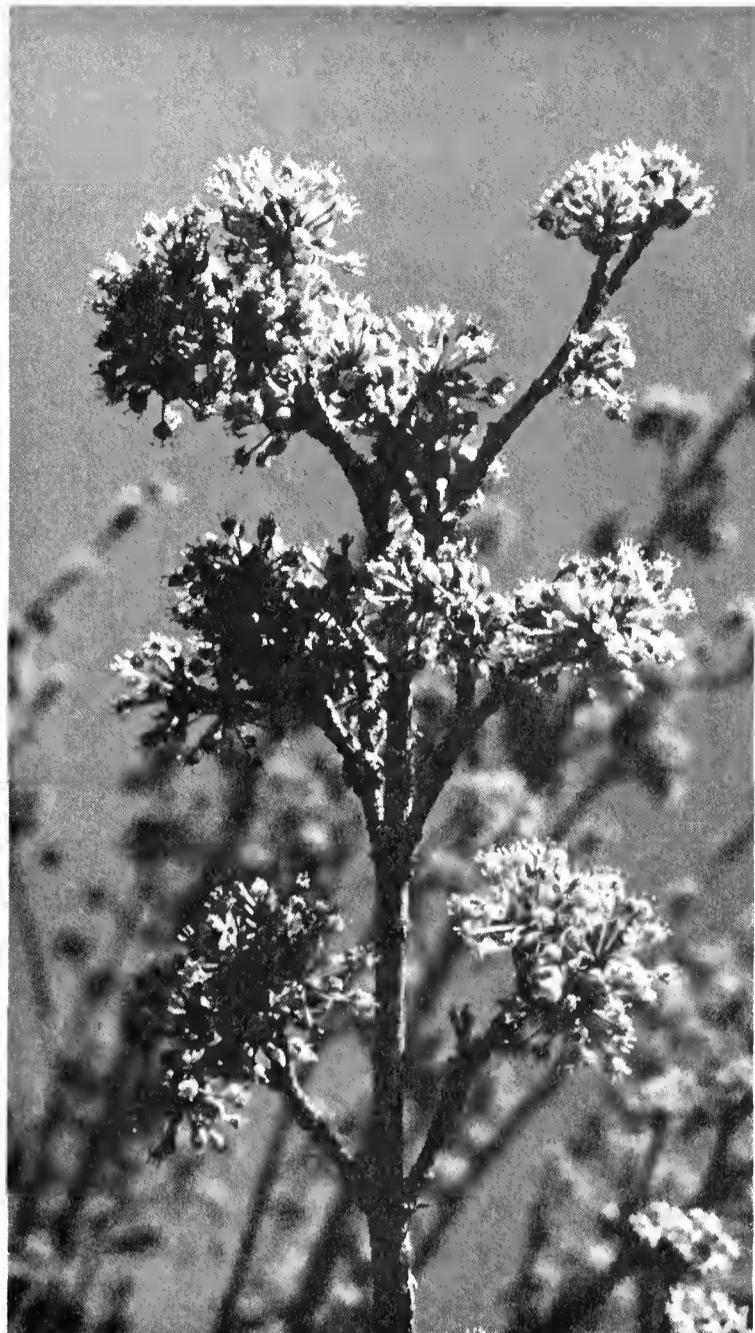
—12'

Form:	upright open
Texture:	medium fine
Flower:	pink
Fruit:	red, small
Fall:	yellow to red





Amelanchier alnifolia, flowers and foliage.

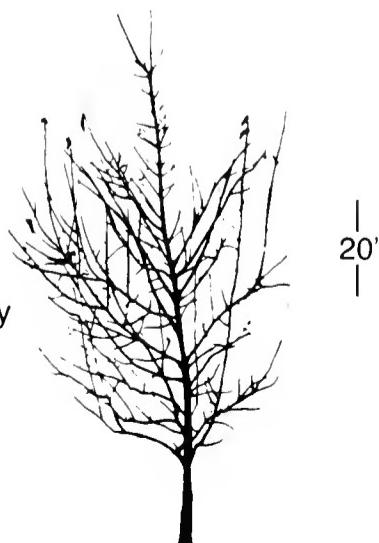


Cornus mas, flowers.

Cornelian Cherry—*Cornus mas*—*Cornus mas* has proven itself for many years in the parks in Denver but has not been used much for home landscaping. It will be 20 feet high and about 15 feet wide. It flowers very early in the spring, sometimes even before *Forsythia*. The flowers are vulnerable to the late spring snows but this tree is still valuable in the landscape. The red fruit is relatively large and edible. It will exhibit red to yellow fall color and is listed as Zone 4 hardiness.

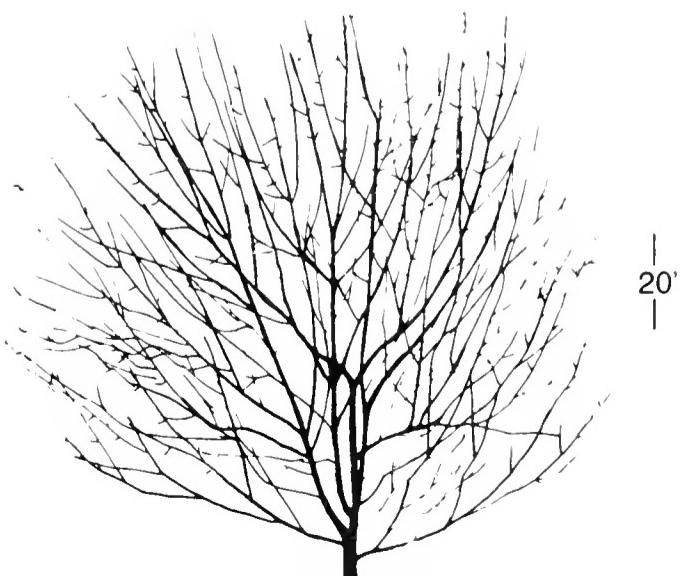
Cornus mas

—15'—



Form: rounded
Texture: medium
Foliage: glossy
Flower: yellow, very early
Fruit: red, cherry-like

—20'—



Tree Form

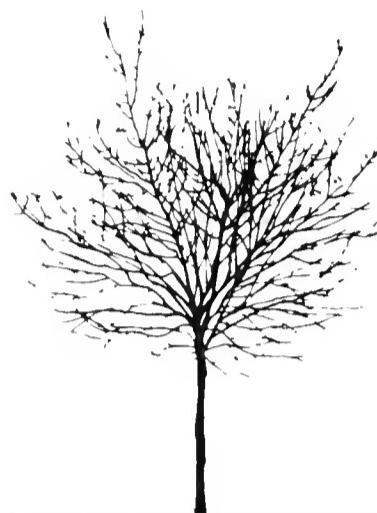
Shrub Form

Grey Dogwood—Another member of the *Cornus* genus, native to the northern mid-American states, is *Cornus racemosa*. It is very tolerant of alkaline soils and will make a small tree 15 feet

tall and 12 feet wide with a compact rounded form. The white flowers in May are followed by white fruit that remain into the fall when the leaves turn purple-red.

Cornus racemosa

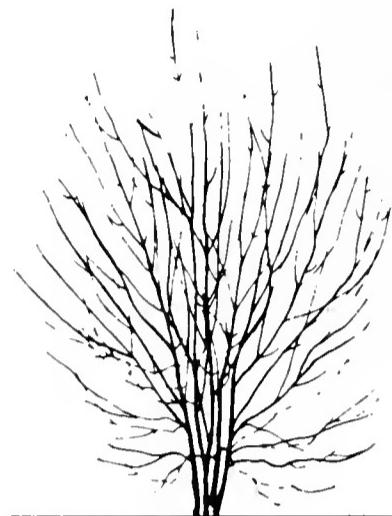
—12'—



Form: rounded
Texture: medium-fine
Flower: creamy, white
Fruit: white
Fall: purple

Tree Form

—12'—



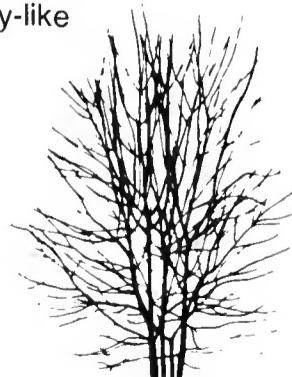
Shrub Form

Japanese Tree Lilac—Most people think of *Syringa* species as shrubs but there are also some excellent trees. The best known in this area is *Syringa reticulata*. It will reach 20 feet and be about 15 feet wide with large leaves. The blooms in June and July are followed by masses of brown seed clusters. The bark is cherry red. The cultivar 'Ivory Silk' is a little more upright than the species, while the cultivar 'Summer Snow' will grow in a compact rounded form.

Chinese Tree Lilac—*Syringa pekinensis* is, as its name implies, another lilac in tree form. In my opinion, this is the best of the tree lilacs. It has a smaller, more refined leaf. Its bark is brownish-red when the tree is young but flakes away to an orange-brown in the mature tree. Its creamy white flowers are similar to those of *S. reticulata*. It will reach a height of 15 to 20 feet. Both *S. reticulata* and *S. pekinensis* are Zone 4 hardy and tolerant of a variety of soil types.

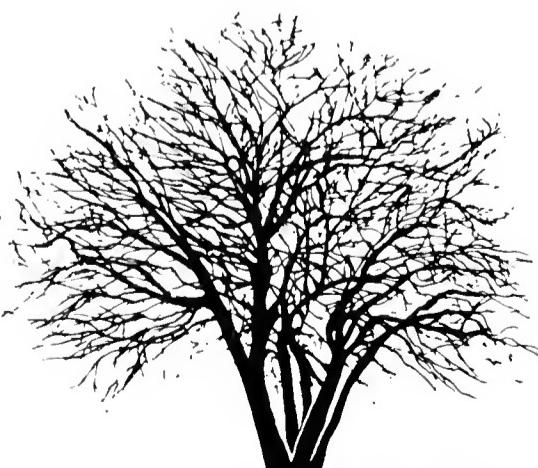
Syringa reticulata

Form: rounded
Texture: medium
Flower: creamy white, fragrant
Fruit: large yellow brown clusters
Bark: cherry-like



Juvenile

—25'—



Adult

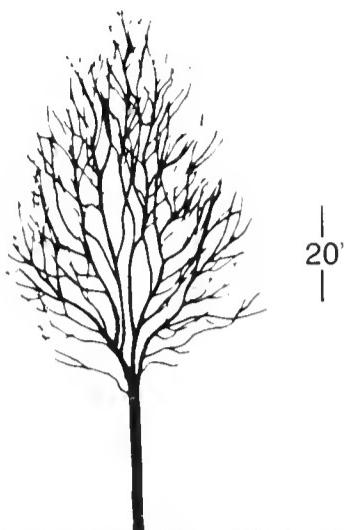
—15'—



Tree Form

Syringa reticulata 'Ivory Silk'

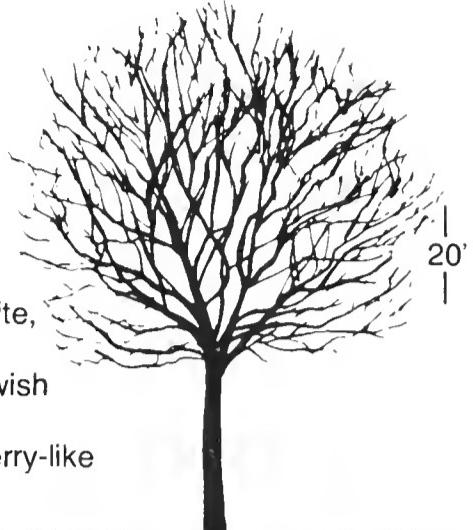
—15'—



Form: rounded
Texture: medium
Flower: creamy white, fragrant
Fruit: large yellowish clusters
Bark: glossy, cherry-like

Syringa reticulata 'Summer Snow'

—15'—



Form: compact, rounded
Texture: medium
Flower: creamy white, fragrant
Fruit: large yellowish clusters
Bark: glossy, cherry-like

Hop Tree—One other small tree that could be used more in gardens is *Ptelea trifoliata*, sometimes called Wafer Ash. This tree has been grown in the Denver area for many years, but has not achieved much popularity. It is native to many parts of North America; there are some native stands in Colorado. (It should be noted that there is disagreement about the nomenclature of this tree.) It will grow in many types of soil with varying degrees of wetness and it is especially useful in Colorado in dry soils. *P. trifoliata* will grow 15 to 20 feet tall and 12 to 15 feet wide. An excellent feature is the very dark green glossy foliage and cherry bark. Although the flowers are not conspicuous, the three-part winged fruit is very striking. It is like thin paper and light green in color. The contrast of the light green fruit against the very dark green leaves gives this tree a unique characteristic to add to our landscape palette.

This list of small trees can help fill your need for more variety. These trees will allow you to emphasize color, texture and seasonal interest when you cannot grow the large specimen trees of a bygone era.

To obtain these trees, contact your local nursery or consult source lists in the library at Denver Botanic Gardens.



Ptelea sp., foliage and fruit.

References

- Dirr, M.A. 1978. *Photographic Manual of Woody Landscape Plants*. Champagne, Illinois: Stipes Publishing Co.
- Horticultural Committee of the Garden Club of America.
- Poor, J.M., ed. 1984. *Plants that Merit Attention*. Vol. I: Trees. Portland, Oregon: Timber Press.
- Rehder, A. and H.A. Rehder. 1987. *Manual of Cultivated Trees and Shrubs Hardy in North America*. Portland: Dioscorides Press.
- Schichtel's Nursery. 1988. *Descriptive Catalog*. Orchard Park, New York: Schichtel's Nursery.

Bonsai: An Interview with Harold Sasaki

We can all bring trees into our lives by practicing the ancient art of bonsai. Neither a backyard forest nor a trek to a wilderness area is essential. With a little guidance, we can produce enduring miniature trees that evoke our own landscape or scenes more distant in space and time.

Bonsai is "the ultimate horticultural art" and "above all, it's fun," according to local expert Harold (Hal) Sasaki of Colorado Bonsai Ltd. Not surprisingly, bonsai is increasing in popularity in our area. To learn more about its basic principles and about bonsai in the Rocky Mountain region, we interviewed Mr. Sasaki.

What is bonsai?

Bonsai is a living art that uses trees, shrubs, herbs, vines and even weeds to create an illusion of an old tree growing in a ceramic tray. Strictly speaking, bonsai means "tray planting." The trees remain small throughout their lifetimes.

But bonsai is really more than a plant stuck in a container. To qualify as a genuine bonsai, the creation must have a mystique. You should feel that you want to spend some time actually in the bonsai—perhaps having a picnic lunch with your best friend under the tree. You should almost hear the birds chirping in the branches.





Why is bonsai so appealing?

Bonsai may be appealing because it's miniature and mysterious. It gives a feeling of peace and well being. But it's very difficult to say why we feel this way about bonsai—and maybe that's the appeal. We can't put our finger on why we are so attracted to bonsai. If we could, the mystery would be lost.

Does the appeal endure?

Yes! You never tire of it. It offers a multitude of feelings at different stages as you work with the plant to transform it into a bonsai. Once you reach a certain threshold, it's almost addictive.

How long does it take to produce a bonsai?
For traditional bonsai, you need time and patience to let the plant grow while you manipulate its form. If you start from seed or a cutting, it can take 3 to 5 years. But American society is different from Japanese society. Americans want results quickly. That's why I'm trying to create materials that allow someone to come in at any level, at any size and at any stage.

Why do bonsai stay small?

You restrict a plant's growth by growing it in a container. But probably more important, you prune it—you never let the plant realize its full growth potential. A third but not a common way is to start

with dwarf material. For instance, a dwarf cypress starts about softball size and requires very little trimming to keep it small.

Flowers don't change size. You can keep leaves small by defoliating a tree, for instance a Japanese maple, about mid-June. If kept in full sun and fairly harsh conditions after that, the plant will have small leaves and good fall color. But if kept in the shade, just a few large leaves will form.

How important is root pruning?

Root pruning is *not* part of the miniaturization process—it actually stimulates growth. Root pruning must be done sometimes to avoid a totally root-bound condition. If roots are growing against the side of the container, extreme heat or cold will burn off the tips.

What species are usually used?

Pines and junipers are classical choices and we have beautiful ones here, including *Pinus ponderosa*, *Juniperus scopulorum* and *J. procumbens*. Unfortunately, people don't want what they are surrounded by. Coloradans want flowering trees while people from the East would give their eye teeth for some of our conifers. Some of the plants to grow indoors in Colorado are: boxwood, cherry, catlin elm, jade, azalea, fig, gardenia, natal plum, schefflera, pomegranate, rosemary and serissa. Outdoor plants include: fir, maple, camellia, cotoneaster, cypress, juniper, myrtle, pine, quince, spruce, zelkova.

What are the best sources for materials?
Commercial nurseries offer many materials. For outside, we are growing Amur maple from seed and predict it will be good for bonsai. For inside, we are developing some flowering species. For example, Fukien tea, *Carmona microphylla*, looks like it will be good for indoor cultivation here. It has a white, waxy flower followed by a small berry that turns rusty red. We are also develop-

ing species of New Zealand tea, *Leptosperma*. In greenhouse conditions, it has a bright flower from the first of January and continues on to March or April. It would be super for Valentine's Day!

What is unique about bonsai in the Denver area?

It's very challenging. I had to learn the requirements of each plant given the low humidity and extremes of temperature. I became interested in bonsai as a boy in Hawaii when I saw an advertisement for maple seeds for bonsai that promised to give seasonal changes. Imagine the thrill of seeing a red leaf for a boy in the tropics! But the maple never grew because the seed never went through a cold period. Here I can grow both tropical and seasonal plants so I have the best of both worlds.

What do you need to create a bonsai once you have a plant?

A tray. This is very important. The tray is both a container for the plant and a frame for the bonsai. So if you create a bonsai, you should take the plant to the shop where you will be choosing a tray, just as you would take a painting to the frame shop.

Potting soil. Most important is drainage, drainage, and more drainage. In this part of the country, we use sifted bark and decomposed granite. Fertility is not as important as composition because we fertilize regularly after planting.

Tools. You can start with small scissors and acquire more tools later.

How often do you repot?

Younger plants need to be repotted every other year, but older plants need it less frequently.

How do you decide what style to shape a tree into—cascade, upright, etc.?

The plant lets you know: it's as simple as that. It should be a style natural to the species. The plant shouldn't be tortured to achieve a specific style.

How often are bonsai watered?

Watering is very difficult. In Japan, apprentices do nothing but water for the first 2-3 years. How often a plant is watered depends on many things including the time of year and where it is displayed. The soil needs to be checked daily and watered when it's dry. That's why people often leave their bonsai with a sitter when they go out of town!

How about overwintering in Colorado?

Trees collected in Colorado and cold regions need a chill or dormant period during winter. For very cold periods, the root zone of plants in ceramic pots must be protected by burying the pot up to the rim in mulch, gravel, sawdust or similar material.

How do you get started?

1. Bring your plant home. Take off the dead or dying branchlets. Take all the hanging branchlets off so you only see horizontal branchlets and some vertical ones.

2. Then think of yourself as a little person climbing the plant from the base to the top. You will need good footholds all along the tree. Thinking of it this way, you can see the skeleton of the plant.

3. Next, rotate the plant to see which side gives the best view of all the twists and turns. That side will be the front and all cutting will be from that view.

4. The lowest and biggest branch is Number 1 branch, the next is Number 2. And then behind them is a back branch to give depth. Take a piece of aluminum wire. Stretch it and wrap it around the stem of Number 1 branch. Stretch out the branch to give a wider view of the plant. Continue this process for other branches, also using the wire to twist branches around to conceal bare spots.

5. By pruning, create an arrow shape on both sides of the branch, wide at the base and narrow to the tip. Also imagine an overall triangle with the apex at the top of the plant, and prune within that triangle until you have a miniature tree!

Hal Sasaki transforming a young *Juniperus chinensis* var. *procumbens* into a bonsai: Fig. 1: uncut plant; Fig. 2: hanging branchlets to be removed; Fig. 3 and 4: removal of branchlets; Fig. 5: same tree less than an hour from Fig. 1. All bonsai pictured in this article were created by Mr. Sasaki.



Figure 1.



Figure 2.



Figure 3.



Figure 4.



Figure 5.



What's the next step?

Join the bonsai society to meet fellow enthusiasts. Take a class or attend a lecture/demonstration: we offer these here at Colorado Bonsai Ltd., at Denver Botanic Gardens and at various other locations in the area. Read a book: the library at Denver Botanic Gardens has a large collection of bonsai books. A selection follows.

References

- Chan, Peter. 1987. *Bonsai Masterclass*. New York: Sterling Publishing Co.
- Classic Bonsai of Japan*. 1989. Nippon Bonsai Association. New York: Kodansha International.
- Koreshoff, D. 1984. *Bonsai: Its Art, Science, History and Philosophy*. Portland: Timber Press.
- Meyer, Jerome. 1988. *The Bonsai Book of Practical Facts*. Purchase, N.Y.: Purchase Publishing Co.

Trees and Trout: A Colorado Forest in a Suburb

by Alcinda Cundiff

Twenty-five years ago, Bill and Lydia Carter's backyard was a windswept patch of new suburb, bare of all plants. Now, a dense forest fills the same space. Aspen leaves flutter in the breeze and trout splash in a pond under a miniature waterfall. Birds nest in the trees and children love to explore the winding paths and hidden corners.

This forest is the Carters' solution to a common problem faced by newcomers to Colorado: A desire to live in the mountains coupled with an aversion to long daily commutes. Now Bill and Lydia avoid not only the commute but also most routine and time-consuming garden tasks. Their shady slice of the mountains is largely self-maintaining.



A walk through the woods

The Carters' forest is just 60- by 80-feet but so thick are the trees and shrubs that boundaries disappear, making the space

Alcinda A. Cundiff is Editor of *The Green Thumb* and a Research Associate in biology at the University of Colorado, Boulder.



seem much larger. To begin the tour, walk across a typical suburban front lawn and enter through a gate into a small side yard. Immediately, you are stunned by the wildness. A large pin oak dominates the area. Ponderosa pine, grape holly, chokecherry and lilac interlock, forming a mosaic of foliage textures. Follow a path curving around a low area, an overflow for the pond, containing native bog birch and currants.

The path curves back around to the main area, passing four blue spruce of varying sizes screening the raised deck. Twinberry, junipers and native roses provide an understory. Aspens are everywhere, volunteers from the original imports.

Another curve in the path leads to the long, narrow pond. Reaching over the water are more native birches and a thin-leaf alder. A native willow trails its branches in the water, replacing a weeping willow grown in the early days for quick shade. A bristlecone pine has been persuaded to recline on the bank. Beyond the pine, a moss-covered log peeps out of the water.

A few more steps down, the path widens to a round brick patio shaded by a tall honey locust. In the center is a flower bed planted with annuals. Next comes a concolor fir, 16-feet tall, a graceful, healthy tree that began as a sickly 4-foot

transplant. Continue on to a picnic area, the table just visible through the trees. Beyond the table is a little leaf linden, flourishing despite a broken leader years ago. Tam junipers and serviceberry surround the area.

Retracing your steps to the central patio, you pass columbines on the left and a sandy bed on the right, filled with mixed wildflowers. Another path, up a few steps to the right, passes a hawthorn, a cut-leaf sumac and a native plum, its seed introduced by the birds. This path terminates in an area of lodgepole pine, spruce and oak. Here, a small terrace contains a sunken firepit, evocative of mountain campfires. Amur maple, native hazelnut and western thimbleberry are the understory.

Turn back and continue to a little bridge over the pond to enter a circular trail bordered by birch and pine. A native scrub oak spreads over the fence; beneath are tall raspberries. A spur from the path leads to a hidden bench on the pond bank. Sit enclosed in green walls and watch the fish swim lazily by, the tour complete.

Shaping a forest from clay

Although Bill spent thirteen years in the landscaping business, he didn't start with a plan for his own garden. He knew he wanted a "woodsy feel" with lots of shade and shelter from the wind.

The first step in turning the featureless ground into a forest was to bring back the soil removed by the builders and rebuild a natural slope. Drainpipes were installed



to carry runoff from the neighbors' watering out to the front lawn. A privacy screen of Austrian pines planted along the back wall quickly became a valuable wind-break, probably explaining much of the Carters' eventual success. The pines also discouraged the deer, another important part of the program.

Next, the thick clay was hand-turned with an English-style spading fork—an adequate rototiller wasn't available when the Carters began. The entire yard was turned to a depth of at least a foot. Planting holes were dug one and a half feet deep and as wide as possible. Sand was worked in coarsely to provide air pockets. Bill maintains that thorough

and ignored. Most important, he says, is to mix sizes to get a natural effect.

A closed system

For the first few years only, phosphate was dug in and a balanced fertilizer was added. Wood chips were also imported until Bill acquired a small chipper; now he makes his own mulch from pruned and fallen branches. A rich, black mulch a foot deep, springy underfoot and full of earthworms, covers the ground. Best of all, the forest needs little supplemental water—a good soaking about once a month is all that is required. Some plants haven't made it on this regime. They have died and have either been replaced

Bill Carter's Prescription for A Suburban Colorado Forest

- Dig the soil deeply throughout the area
 - Work sand *coarsely* into clay
 - Add *small* amounts of peat or compost to planting holes
 - Fertilize initially but not continually
 - Plant small trees densely
 - Ignore most pests
 - Mulch heavily
 - Water rarely
 - Prune lightly
 - Build a pond
-

mixing of sand and clay will make adobe. A small amount of sphagnum peat moss or compost was added to planting holes: too much may aggravate drainage problems and lead to tree-killing salt accumulation.

The Carters prefer native species but aren't purists. Many of their plants came from local nurseries. Bill credits Larry Watson (see article this issue) with leading him to many of his best plants, ones that weren't commonly available at the time. Bill advocates starting with small trees. Many of his giants were planted as 4-5 feet saplings, some came from 5 gallon containers, and a large bur oak sprang from an acorn he planted in a pot

by surrounding plants or by ones from bird-dispersed seeds.

Pests and other problems

Bill prunes lightly every year and more heavily every 2-3 years. He prunes both to remove diseased and damaged branches, and to shape the trees for maximum effect. Bill rarely uses pesticides although he does admit to applying slug bait occasionally. He ignores aphids and mildew and simply cuts down aspens heavily infested with borers. New trees sprout to take the place of the damaged ones. The general impression is of a very healthy stand of trees and shrubs, resistant to assaults by all pests except

squirrels, whose constant scampering up and down the trees damages the bark.

Bill seems to have a pragmatic approach to trees. He plants very densely, not worrying about the eventual size of the trees. This gives him the effect he's after in a short time. The trees suffer natural attrition or get moved when they grow too large for a particular spot. Competition doesn't seem to be a problem. Bill thinks the density actually helps the trees; although they may compete for resources, the shade reduces evaporation and the reduction in wind velocity prevents breakage.

The pond

Most of the trees were planted before the pond was installed. Bill dug a long narrow pond following the downward slope of the yard. A pump recirculates the water, but occasionally fresh water must be added. This is sprayed in to help remove the chlorine toxic to the fish. A filter under the gravel keeps the water clean. The pond was lined with plastic years ago and is still holding water. The edge consists of stones covering the plastic but Bill thinks a discreetly-hidden concrete curb would be preferable. Occasionally the pond overflows into a low area near the front yard, supplying water for the plants there.

Mosquitoes don't breed in the rapidly moving water but crayfish do. Raccoons go after the crayfish but don't seem to be able to get the trout. Bill speculates that the 2-foot depth discourages them. The trees shade out the algae and the trout need little care. All in all, it's surprisingly little work for a major addition to the garden.

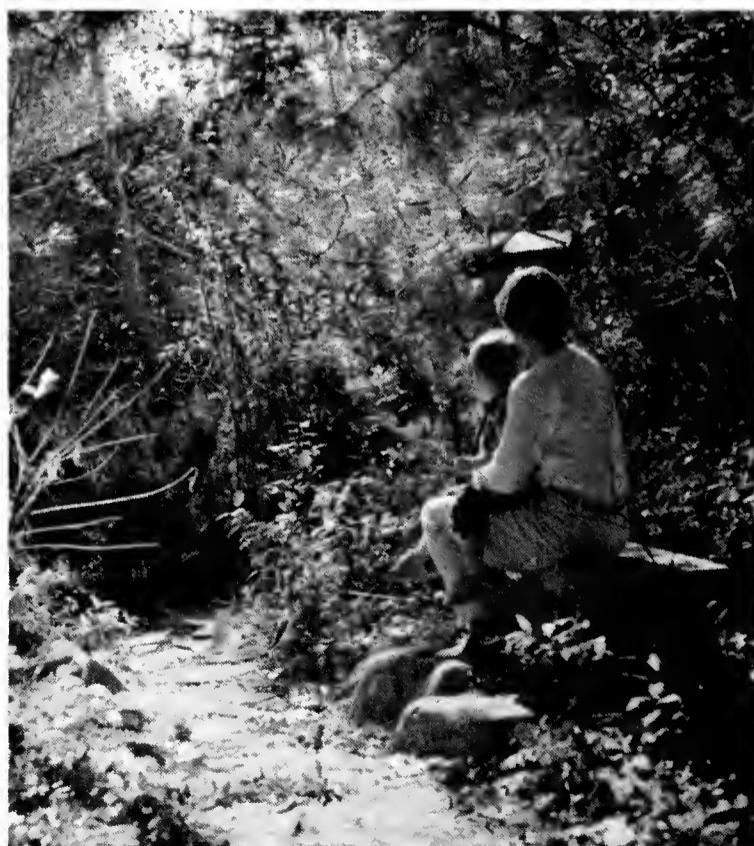
The future

Bill is always learning—from experts like CSU's landscape plant authority Jim

Feucht, from observations of native habitats, but mostly from his own trees. His major goal is simply to adjust to the naturally occurring changes but he does have current projects: looking for more understory species that can take dry shade, further masking the boundaries of his lot, and extending his trees and pond to the front of his home.

A forest in the foothills—natural or not?

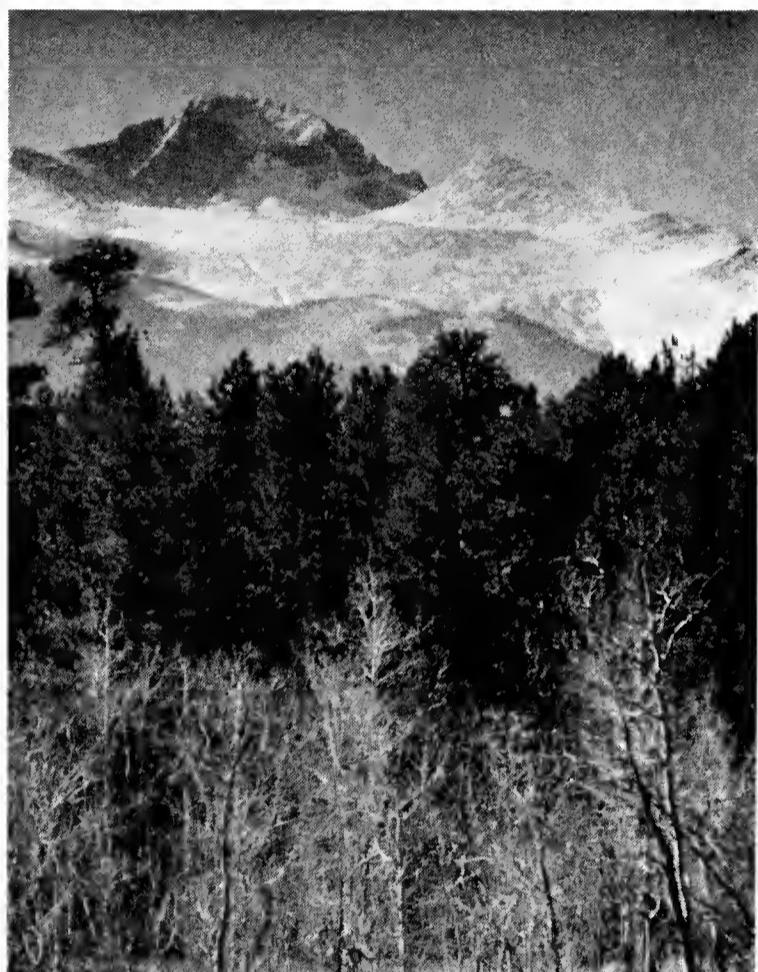
The Carters' forest is natural but not endemic. No such forest exists in the surrounding foothills, nor does it even truly mimic natural stands at higher elevation. This raises an important question: should we be planting forests in habitats meant for grassland? As long as we feel the need to alter our habitat to make it more livable, a self-maintaining woodland is surely a viable alternative to traditional landscaping with high water requirements. And in this time of rising temperatures and declining water supplies, planting trees is a gift to the future.



Forests of Colorado

To many Colorado residents as well as visitors, forests are the most familiar component of our state's vegetation, although in fact they cover only about 20 percent of the state. Colorado's forests consist mainly of cone-bearing (coniferous) trees, in some settings intermixed with patches of aspen—a fact known to anyone who has seen the beautiful fall color for which these deciduous trees are famed! Our forests may be differentiated into distinctive life zones, beginning at elevations of approximately 5000 feet at which the lower montane forests border grasslands, shrublands, or woodlands, and ending at about 11,500 feet, where subalpine forests gradually or abruptly meet alpine tundra.

At the lowest elevations, ponderosa pine (*Pinus ponderosa*) forests are typical. These forests often have an understory composed mainly of grasses, although the species found differ with geography. In other areas, shrubby understories occur. For instance, in southern Colorado, Gambel's oak (*Quercus*



Ponderosa pine Forest in Lower Montane Zone above Boulder.

gambelii) often is present; in other areas, bitterbrush (*Purshia tridentata*), mountain mahogany (*Cercocarpus montanus*), wax currant (*Ribes cereum*), and squaw-bush (*Rhus trilobata*), are important forest understory components.

In areas of intermediate elevation, coniferous forests may be more complex, often including two or more tree species in association. In these forests, snow may accumulate to depths of two or three feet, making the areas cooler and more moist than the ponderosa pine forests. The most common trees are douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), lodgepole pine (*Pinus contorta*),

This article is reprinted from *Rare Plants of Colorado* (reviewed in this issue) with kind permission of the publishers, the Colorado Native Plant Society and the Rocky Mountain Nature Association. Research for the article was by W. Moir; editing and writing were by W. F. Jennings. This is the final article in a series on natural areas of Colorado. The initial article appeared in *The Green Thumb*, 1986, 43(1):17-24, followed by articles on alpine tundra [43(2):54-58], mountain meadows [43(3):79-81], plains [44(1):1-12], the barrens [45(1):8-15], and wetlands [45(2):38-4].



and aspen (*Populus tremuloides*). On north-facing slopes, one often finds closed stands of douglas-fir associated with such shrubs as jamesia (*Jamesia americana*), rocky mountain maple (*Acer glabrum*), or ninebark (*Physocarpus monogynus*). Across the canyon on the southerly slopes occur open stands of douglas-fir and ponderosa pine with an understory of grasses. At higher elevations, douglas-fir, lodgepole pine, ponderosa pine, and limber pine (*Pinus flexilis*) may form mixed stands. Because douglas-fir is the most shade tolerant of these conifers, it eventually becomes the primary tree of old-growth forests. South of Colorado Springs, white fir becomes common. Such white fir forests are primarily southwestern, being widespread in Arizona and New Mexico. In central and northern Colorado, forests of lodgepole pine are common. Where this tree reproduces well, or where there have been recurrent hot fires, lodgepole pine produces a climax or fire-climax community. In such forests, there is little evidence that more shade-tolerant trees ever will replace lodgepoles. Understories in these forests typically are very sparse.

Above about 9000 feet, the sub-alpine coniferous forests include subalpine fir (*Abies lasiocarpa*), engelmann spruce (*Picea engelmannii*), lodgepole pine, and aspen. Precipitation exceeds 30 inches per year, compared to 18-25 inches in ponderosa pine forests and 25-30 inches in montane forests. Snow accumulates to

depths of more than three feet, and persists well into June. At the lower elevations in these forests, lodgepole pine and aspen are common, often gradually being replaced by engelmann spruce or subalpine fir. However, nearly pure stands of lodgepole and aspen may persist for centuries. At the upper elevations of the subalpine forest, the climate is too severe for lodgepole or aspen, and forests consist mainly of subalpine fir and engelmann spruce. The understories of such forests are highly variable, but can be rich and luxuriant, especially where moisture is present throughout the growing season. Special ridgetop or upper slope, exposed, windy sites with shallow soils or excessive runoff are environments in which limber or bristlecone pines (*Pinus aristata*) are found, either in nearly pure stands or sometimes with other subalpine trees.

At timberline, the change from forest to alpine tundra may be abrupt, or a transitional mosaic of trees and tundra may occur. Here trees are dwarfed, and often become markedly one-sided or flag-form. These wind-sculpted trees form shrub-like islands; these often are called "krummholz," the very appropriate German word meaning "bent tree" or "crooked tree."

Importantly, a forest consists of more than just the trees; it is home to communities that include some of the rarest plants in the state. One of the most beautiful rare plants in Colorado, the wood lily

(*Lilium philadelphicum*), is disappearing quickly because it is loved too much—populations are decimated by picking or transplanting. Several other plants, including white-flowered azalea (*Rhododendron albiflorum*) and trillium (*Trillium ovatum*), are able to exist in Colorado because the forest trees temper the harsh environment, creating conditions approximating those found in cool northwestern forests.

Except in a few wilderness areas or parks, the forests of Colorado reflect present and past disturbances created by

logging, mining, railroads, livestock grazing, skiing, camping, and changes in fire regimes associated with a growing human population. The influence of distant urbanization, particularly in the form of air pollution, is subtle but real. Air pollution may damage forests imperceptibly to the eye, but in ways that contribute to increases in insect and disease outbreaks, and in mistletoe parasitism. Thus, even forests that appear to be primeval, pristine, or otherwise minimally influenced by man, nevertheless are affected to some degree.

Societies: Native Plants and Conservation

Listed here are societies concerned with plant conservation and native plant gardening. Write or call them for more information about conservation activities and/or membership.

The Center for Plant Conservation
The Arnold Arboretum
Harvard University
The Arborway
Jamaica Plain, MA 02130

Colorado Native Plant Society
Box 200
Fort Collins, CO 80522

Colorado Natural Areas Program
Dept. of Natural Resources
1313 Sherman St. Room 718
Denver, CO 80203
Phone 303-866-3311

The Conservation Foundation
1250 24th St. NW
Washington, DC 20037

Friends of the Earth
530 Seventh Street SE
Washington, DC 20003

The Garden Club of America
598 Madison Avenue
New York, NY 10022

National Wildflower Research Center
2600 FM 973 North
Austin, TX 78725

The Nature Conservancy
Ste. 800, 1800 N. Kent St.
Arlington, VA 22209

Operation Wildflower
National Council of State Garden Clubs
Mrs. C. Norman Collard, Chairman
Box 860
Pocasset, MA 02559

The Sierra Club
730 Polk Street
San Francisco, CA 94109

Soil Conservation Society of America
7515 Northeast Ankeny Road
Ankeny, IA 50021

The Wilderness Society
1400 I St. NW, 10th Floor
Washington, DC 20005

Herbs for You: Guidelines for the Rocky Mountain Gardener

by Gloria Falkenberg

Let herbs open new doors for you! Find new sources of gardening pleasure with these ancient and honored plants. Whatever your interests, herbs are involved: archaeology, art, literature, landscaping, dyeing and weaving, medical treatments old and new, cooking or simply wandering through a garden full of delightful fragrances.

Herbs (pronounced either *herbs* or *erbs*) were called "a friend to the physician and the praise of cooks" by Charlemagne. Technically, a herb is a plant whose stem does not become woody or a plant that is valued for its medicinal properties, flavor or scent. Generally, herbs tend to be plants with aromatic leaves most often found growing in the temperate zone while spices are the roots, seeds or bark of plants native to the tropics.

Gloria Falkenberg was instrumental in the development of the Herb Garden at DBG and has presented programs on herbs throughout the Front Range. She has been a member-at-large of the Herb Society of America since 1972 and received its Certificate of Achievement Award in 1988 for more than 30 years of commitment to herbal knowledge and horticulture. She was a founding member of the DBG Guild and continues to serve DBG in numerous capacities; among others, as a member of the Board of Trustees.



Sage, *Salvia*.

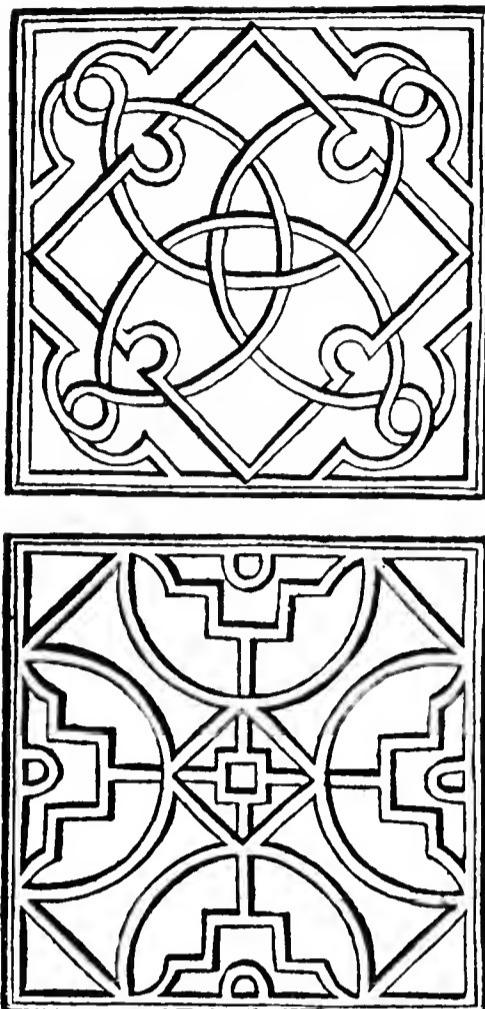
It is particularly important to correctly identify plants for herbal uses and cooking. Latin names provide the precision necessary to avoid mistakes. For instance, garden sage used in cooking (*Salvia officinalis*) is very different from the sage of our plains and mountains (*Artemisia frigida*) and the Latin name makes the difference clear. The first time a herb is mentioned below, both the Latin and common names are given. Only the common name is given thereafter.

History

The history of herbs is the history of mankind. Flowers and herbs were cultivated in the temple gardens of ancient Greece and Egypt. Garlands and wreaths of herbs were an inseparable part of every festive public and religious occasion. They adorned statues and altars; they were awarded to public servants, bestowed on poets, athletes and military heroes. They were exchanged by lovers and used as funeral decorations. The Romans brought to Great Britain 400 herbs, learned from the Egyptians, Greeks and Indians.

In the Dark Ages, knowledge of herbal lore was kept alive in the physic gardens of monasteries. It was transmitted to the Middle Ages through hand-copied herbals. From the great period of miniature painters in the 14th and 15th centuries came our first pictures of enclosed castle herb gardens. During the Renaissance, great competition in formal herb gardens developed, giving rise to complicated geometric plantings and ultimately to the gentle knot gardens of the Elizabethans.

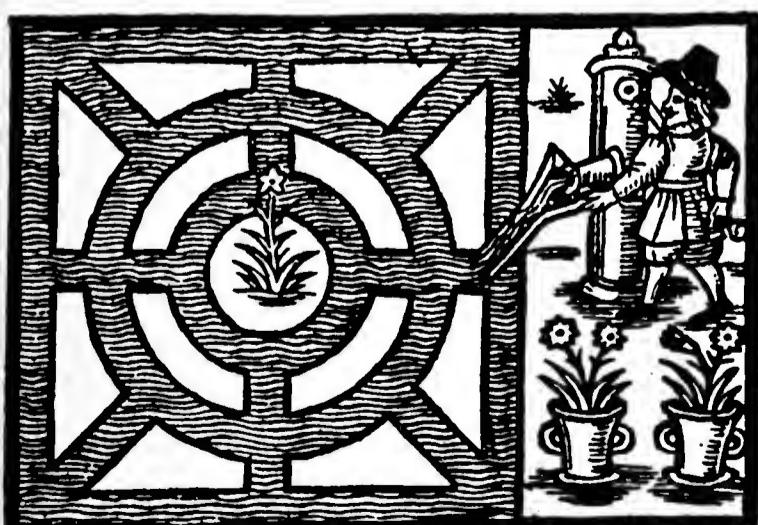
Although herb gardens in North America date from the American Indians and early colonists, herbs were grown primarily for medicinal and culinary purposes rather than for their beauty. The long period of neglect of herbs in this



Knot garden plans.

country may have begun in Puritan New England. Almost every herb has been considered an aphrodisiac at one time or another. Many herbs were banned "on the supposition they excite passion" and because of their association with witchcraft. Contributing to the decline in interest was the increase in refrigeration: herbs were no longer needed to mask overripeness. Artificial seasonings further eclipsed natural herbs. By the 19th and early 20th century, cookbooks recommended only bland seasonings

Prior to World War II, the usual seasonings in the American home were salt, pepper, clove, cinnamon, nutmeg and vanilla. Even garlic was not an everyday flavoring. Returning soldiers brought new knowledge of herbs and spices. Cookbooks poured off the presses. Now the interest in herbs has been reawakened: cooks and gardeners are finding these plants obliging and decorative additions to their gardens.



Watering from a pump, from *The Gardener's Labyrinth* (1651).

Gardening with herbs

Design

Herbs lend themselves to either formal or informal gardening. A formal knot garden such as the one at Denver Botanic Gardens is beautiful but requires constant maintenance and has more herbs than the average individual needs. However, this garden provides guidelines for varieties, height and placement of herbs to use in planning a home garden.

Consider the informal look of colonial gardens, cottage gardens and popular perennial gardens in which herbs are freely mixed with other cherished plants. For a home garden, consider tucking herbs among other plantings for their ornamental appearance or for color contrast. A border of opal basil and white petunias is an outstanding example of strong color contrast. The silvery leaves of lamb's ears (*Stachys byzantia*), the artemisias (*Artemisia* spp.), lavender cotton (*Santolina* spp.) and lavender (*Lavandula* spp.) will all brighten or accent green foliage.

Consider the beauty and fragrance of lemon or wooly thyme (*Thymus*

pseudolanuginosus) in a border, between stepping stones or tucked into rock gardens and walls. Some medicinal and culinary herbs are ornamental perennials: costmary (*Chrysanthemum balsamita*), orris root (*Iris germanica florentina*), lovage (*Levisticum officinalis*), lemon balm (*Melissa officinalis*), comfrey (*Symphytum officinale*) and tansy (*Tanacetum vulgare*). Remember that the powerful medicinal and allergenic herbs should be planted safely beyond touch and taste.

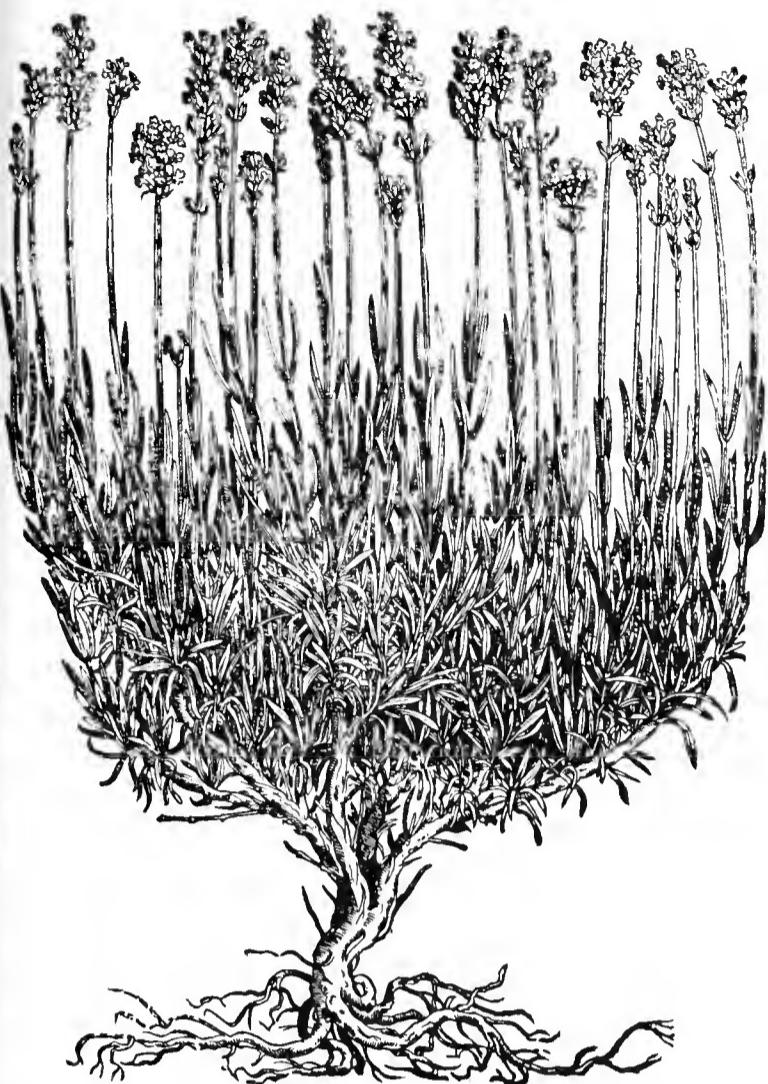
To practice herb gardening on a smaller scale, consider a culinary herb garden by the kitchen door or patio, or plant herbs in decorative pots, strawberry jars, a wagon wheel or ladder. The ideas and opportunities are endless.

Culture

Outdoor Gardening

Herb growing requirements are similar to those for other plants: water, good garden soil with good drainage and at least half a day of full sunlight for most species. The few shade lovers include sweet woodruff (*Asperula odorata*), chervil (*Anthriscus cerefolium*) and angelica (*Angelica archangelica*).





Lavender, *Lavandula*.

To offset the alkaline soil of Colorado, add peat or compost. To lighten heavy clay soil, add sand but mix in coarsely: sand mixed thoroughly with clay will produce a mixture similar to concrete. Generally 3 inches of peat plus 2 inches of compost spaded in and turned to a depth of 6 to 8 inches will make a good soil. This process will control your enthusiasm and the size of your garden.

Most herbs prefer dry soil, making them very suitable for our climate. Good soil drainage is essential. Deep cultivation and the addition of compost and peat will improve drainage. Alternatively, consider using raised beds. Note however that annual herbs require more water than perennials.

In good soils, fertilizers may not be needed for a few years. Fertilizer produces lush growth but does not enhance the production of the fragrant essential oils. When using chemical fertilizers, choose one with a high middle number,

follow directions carefully and work into the soil thoroughly. Concentrated fertilizer can burn the roots of established plants and seedlings.

Fortunately, the same fragrant oils that make herbs attractive to us make them unattractive to most pests. Outdoors, few insects require control. Herbs brought indoors for windowsill gardening in the winter may be infested with white fly. Wash the leaves with soapy water at intervals of two weeks for control without pesticides.

Herbs are most easily started from small plants purchased in spring. (The Denver Botanic Gardens plant sale offers a wide selection.) As your interest increases, you might try to raise plants from seeds or propagate from existing plants by rooting cuttings or layering.

A list of cultural guidelines for several species accompanies this article. Don't be intimidated by this list: remember that most herbs will grow well in the Front Range if you simply dig a hole in the garden, plop in a plant and water it now and then!

Companion planting

Gardening lore claims that planting specified herbs near other plants will deter certain pest insects. While many of these ideas await scientific testing, so-called companion plants may help reduce the use of persistent pesticides. Below is a list of plants, their companions and the insects they are said to deter.

Borage (*Borago officinalis*): tomatoes and strawberries: tomato worm.

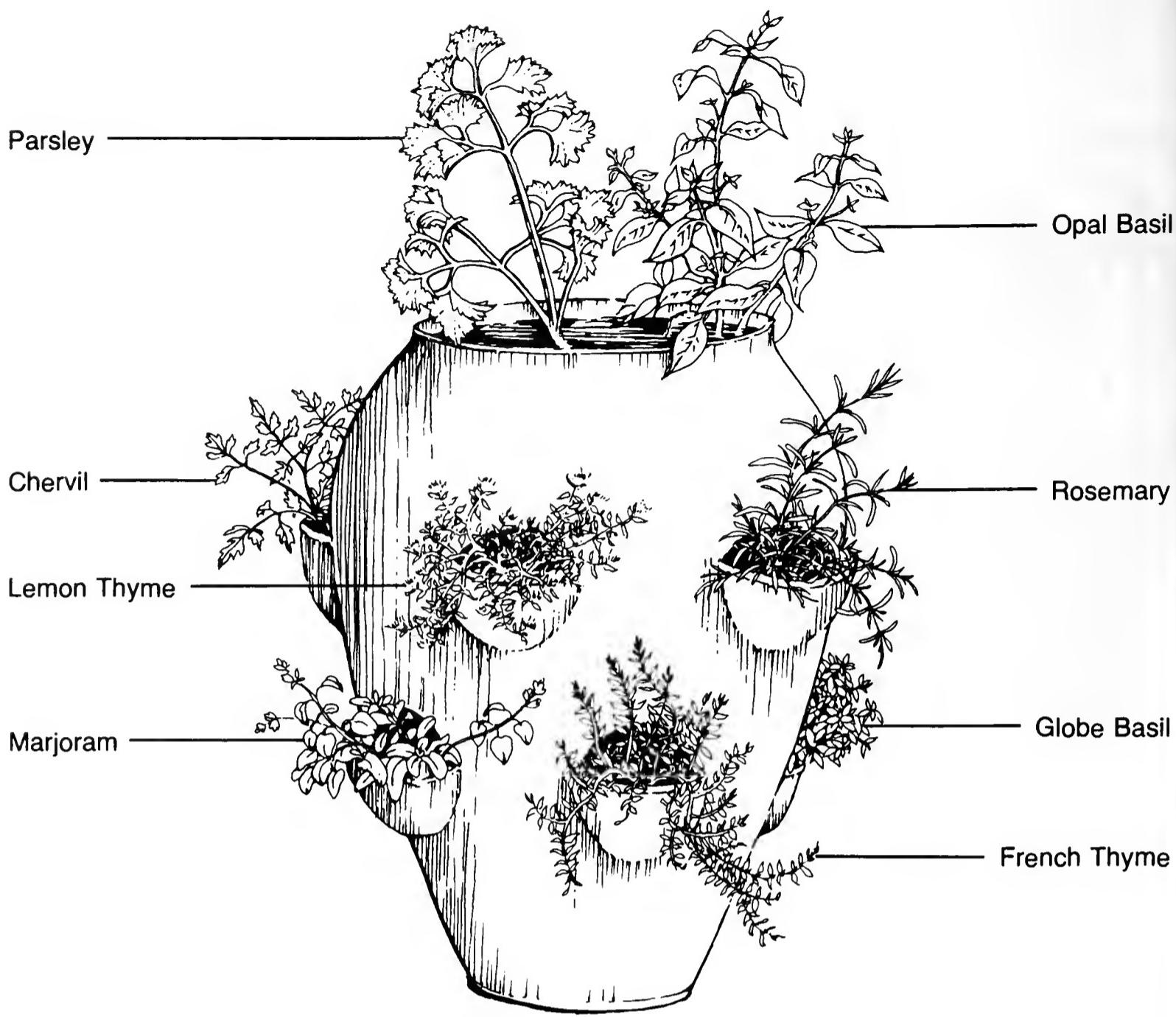
Catnip (*Nepeta cataria*): many plants: flea beetles.

Garlic (*Allium sativum*): roses and raspberries: Japanese beetle.

Marigolds (*Tagetes spp.*): many plants: nematodes.

Nasturtium (*Tropaeolum majus*): fruit trees, radishes and cabbages: aphids.

Summer savory (*Satureja hortensis*): onions and beans: bean beetle.



Strawberry Jar by Rob Proctor.

Indoor Gardening

Herbs are grand container plants. Easy to grow, they favor the good drainage that pots allow and are adaptable. Often herbs are even more attractive in pots than in the garden. One is able to enjoy their fragrance, leaf shape and texture more easily. They also can be moved around the deck or patio or from room to room, to follow the seasonal sun.

Containers can be clay pots, clear plastic squares, drain tiles, concrete blocks, baskets, bleached wooden trays and strawberry jars. If there is no drainage hole, put some charcoal and 1/2 inch of pebbles in the bottom of the container to keep the soil sweet and the roots out of water.

To plant a strawberry jar, start with a packaged potting mix. To keep soil from clogging the drainage hole, cover it with a broken piece of pottery or a square of screen wire. Next add a layer of pebbles or

small rocks to improve drainage and then a layer of soil.

Next, down the center of the jar insert a plastic tube pierced with holes. A plastic golf club protector an inch shorter than the jar and pierced with a skewer is also effective. To keep it open, cover the tube with foil or plastic. As a watering pipe, the tube allows water to seep out to all plants through the length of the jar.

Add soil and plants, working from the bottom up. The secret is to plant from the inside out, that is, the leaves go down and out the opening as you settle soil around the roots. Continue around the lower cups. Then add more soil, firming it as you move upward to the second layer of cups. Keep the tube centered throughout this process. Yes, it can be done with just two hands! When you finish planting, water gently through the tube and prepare to enjoy your portable herb garden.

Uses

Although you do not need to use herbs to enjoy them, should you decide to experiment with herbs in cooking, you'll be amazed at the difference that fresh or freshly dried herbs make to your favorite dishes. Suggestions for specific combinations are given for each species in the lists below. Here are some general guidelines:

1. Use sparingly: the flavoring should be subtle—just enough to suggest that something different has been added but not enough to taste the herb itself.

2. A pinch of dried herb will flavor a serving for two people. One-quarter teaspoon will flavor a serving for four people.

3. Add herbs toward the end of the cooking period. Fresh herbs should be added just before serving or flavor will be lost. Add dried herbs to soups or stews during the last hour of cooking. In quickly cooked food, marinate one hour before in a small amount of cooking liquid.

4. To substitute fresh herbs for dried herbs, use three to four times the amount of dried herbs specified.

5. Use 1/2 teaspoon of dried herbs for each 2 cups flour in herb biscuits or dumplings.



Herb seedlings for sale at Denver Botanic Gardens plant sale.

Herbs to Grow

These are listed in order of usage and ease of culture.

Basil — *Ocimum basilicum*: Annual 8-12 in.

Culture: Space 12 in apart in sun or light shade. Warm weather.

Flavor: Mild flavor of anise and cloves; slight mint aftertaste.

Uses: Casseroles, sauces (especially tomato), salads, pesto.

Sweet Marjoram — *Origanum majorana*: Annual 6-12 in

Culture: Space 12 in apart in light, average soil. Full sun. Good houseplant.

Flavor: Sweet and spicy. Less pungent than sage.

Uses: Seafood, soups, eggs, meats, poultry, stews, salads, sauces, liver.

Oregano — *Origanum vulgare*: Perennial 15 in.

Culture: Space 1 ft apart in medium rich, well-drained soil. Full sun. Divide every 2-3 years.

Flavor: Pleasant and aromatic.

Slightly stronger than sweet marjoram.

Uses: Bean soup, cabbage, lamb, ground beef.

Rosemary — *Rosmarinus officinalis*: Tender perennial 12 in.

Culture: Light, warm, well-drained, limy soil in sunny, protected spot. Cut slips and bring inside for winter. Interesting houseplant.

Flavor: Pungent and piny; use sparingly.

Uses: Pork, eggplant, salads, soups, gravies, lamb, chicken, sachets and pot pourris, tea.

Tarragon — *Artemisia dracunculus*: Perennial 2-3 ft.

Culture: Space 18 in apart in rich, warm, well-drained soil. Sun or part shade. Divide every 3 years. Propagate by root cutting.

Flavor: Sweet, astringent, licorice-like flavor.

Uses: Vinegar, steaks, chops, salads, fish, chicken, sauces.

Thyme-French — *Thymus vulgaris* var.: Perennial 9 in.

Culture: Space 10 in apart in light, sandy, well-drained soil. Full sun.

Flavor: Warm, pungent, strong.

Uses: Bouquet garni, vinegar, eggs, vegetables, stews, seafood.

Sage — *Salvia officinalis*: Perennial 2 ft.

Culture: Space 18 in apart in sandy, dry soil. Full sun. Do not over water.

Flavor: Fragrant, slightly bitter, strong.

Uses: Poultry stuffing, sausages, pork, cottage cheese, teas, lima beans.

Chives — *Allium schoenoprasum*:

Perennial 12 in.

Culture: Space 5 in apart in medium rich soil. Sun or part shade. Divide every 3 years.

Flavor: Mild, onion taste.

Uses: Soup, salad eggs, sauces.

Summer Savory — *Satureia hortensis*:

Annual 18 in.

Culture: Space 6 in apart in dry, medium rich soil. Full sun. Will reseed.

Flavor: Slightly resinous and piquant.

Uses: Meats, soups, salads, vegetables (especially beans), pork, veal.

Salad Burnet — *Sanguisorba minor*:

Perennial 12 in.

Culture: Space 15 in apart in moderately dry, poor, sandy soil. Sun or light shade. Almost evergreen.

Flavor: Distinct delicate taste similar to fresh cucumber.

Uses: Salads, vinegars, iced drinks, as a garnish. Attractive in flower borders.

Dill — *Anethum graveolens*: Annual 1-2 ft.

Culture: Space 6 in apart in average soil. Full sun. Self-sows.

Flavor: Sharp, aromatic, caraway-like taste.

Uses: Leaves used in meats, fish, potatoes, soups. Seeds used in pickles and vinegar. Attractive in flower arrangements.

Fennel — *Foeniculum vulgare*: Annual

3-4 ft.

Culture: Space 6 in apart in full sun. Matures in 60 days.

Flavor: Mild licorice taste.

Uses: Soups, salads, fish. Root eaten like celery. Floral arrangements.

Sweet Woodruff — *Asperula odorata*:

Perennial 6 in.

Culture: Shady, moist soil.

Flavor: Mossy or dried like new mown hay.

Uses: May Wine, pot pourris.

Parsley — *Petroselinum crispum*: Biennial 10 in.

Culture: Average soil; part shade or sun. Space 8 in apart. Water frequently.

Flavor: Acid-sweet pungency.

Uses: Soups, salads, meat loaf, cheese, eggs, fish, sauces. Source of vitamins and minerals. Popular as garnish.

Chervil — *Anthriscus cerefolium*: Annual 12-18 in.

Culture: Fresh seed, rich soil, part shade, successive sowings.

Flavor: Mild parsley-tarragon flavor.

Uses: Sauces, salads, vegetables.

Final thoughts

An herb garden created in the imagination and planted by the gardener's own hands brings some of the purest joys in life: beauty in color and form; bird song and the hum of bees; the music of wind and rain; a pleasure of flavors and fragrances; and the delight in touching silken or velvety leaves. Friends come to enrich our happiness, bringing love, inspiration and a sense of completion.

References

Boxer, A. and P. Bock. 1980. *The Herb Book*. London: Octopus Books, Ltd.

Foster, Gertrude B. 1973. *Herbs for Every Garden*. New York: E.P. Dutton.

Lathrop, N.J. 1983. *Herbs: How to Select, Grow and Enjoy*. Tucson: HP Books.

Tolley, E. and C. Mead. 1985. *Herbs: Gardens, Decorations and Recipes*. New York: Charleston and Porter.

The Waring Rare Book Room

by Solange Gignac

The Waring Rare Book Room (WRBR), in the northwest section of the Helen Fowler Library, houses the rare treasures of the library collection. The room occupies 252 square feet. The eastern wall provides 141 linear feet for storage of the books. Windows take up most of the available space on the northern and western walls except for the shelving below the window ledges. The south wall space is taken up by the entrance. The oak book cases are faced with decorative grating to allow for necessary air circulation for the books. A humidifier keeps the relative humidity constant at 50% and the temperature fluctuates between 68 to 72°. Although not ideal for the preservation of books, these conditions are adequate for both the care of the books and for allowing people to use the collection comfortably.

The core of the collection is derived from gifts of Dr. and Mrs. James Waring whose generosity to the Denver Botanic Gardens has been long recorded and appreciated. In their travels abroad, the Warings purchased herbals—early botanic works of European masters—and presented these to DBG upon the completion of the Education Building in 1971. The generosity of Mrs. Waring is also responsible for the Waring Rare Book Room itself. Many of Helen K. Fowler's books on wild flowers of the world and early horticultural and botanical works of American and European origin are also housed in the WRBR.

In 1978, The Library Committee proposed and passed a resolution that at least 5% but not more than 10% of book sale profit be used to purchase accessions for the Waring Rare Book Room. Funds not used during a given year are to be accrued and used later. This policy has been implemented. The size of the collection is such, in 1989, that few acquisitions can be made because of lack of space. Over a period of ten years, the Tremont Foundation contributed an initial donation of \$250 plus a monthly donation of \$100 for "the upkeep and preservation" of library books. More than half this amount, over \$12,000, was used for the repair and re-



The Birch Tree, from *The Herball, or Generall Historie of Plantes*, by John Gerarde, London, 1633.

Solange Gignac is Librarian at Denver Botanic Gardens and a long-time member of the Editorial Committee.

conditioning of the Waring Room collection. At the end of the ten year period, the responsibility for this task was taken over by the DBG Foundation. The annual budget of the library for binding is now \$3000, two thirds of which is devoted to bringing the acquisitions and holdings of the Waring Room to such a condition as to preserve them forever. The library is fortunate to have the services of an excellent bookbinder, Laura Wait, who has over the years rebound, recased, made boxes for and repaired many of the books in the WRBR. It is the ambition of the librarian to leave this institution with a rare book room of unequaled stature as far as the maintenance and upkeep of the collection is concerned.

The Treasures of the WRBR

The oldest book in the collection is *De Historia Stirpium Commentarii Insignes Maximis Impensis et Vigiliis Elaborati . . .* by Leonhard Fuchs, 1501-1566. This herbal, bound in full leather, was published in Basel, Switzerland in 1542. Agnes Arber, botanical historian, writes in *Herbals: Their Origin and Evolution, A Chapter in the History of Botany 1470-1670*: "In spite of his professional activity, Fuchs found time to produce a botanical masterpiece, which appeared in 1542 from the press of Isingrin of Basel, under the title *De Historia Stirpium*: This was a Latin herbal dealing with about four hundred native German, and one hundred foreign plants." The Latin text is adorned with copious full page illustrations, many of which are hand colored.

The oldest book in English in the collection is *The Herball of Generall Historie of Plantes* by John Gerard, 1545-1607, the best known of English herbalists. The edition which the HFL owns is that of 1636, which according to Arber is "an improved edition, brought out by Thomas Johnson in 1633, thirty-six years after the work was originally published." Johnson is chiefly remembered as the editor of Gerard. Arber states: "His edition contained an account of no less than

2850 plants. Johnson also corrected numerous errors, and the whole work, transformed by him, rose to a much higher grade of value. It was reprinted, without alteration in 1636."



Lactarius hygrophoroides Berkely & Curtis in the *Mushroom Book* by John Cage, Lois Long and Alexander H. Smith, New York, 1972.

Of the works of John Parkinson, 1567-1650, British hebalist and cultivator of a famous London garden, the library has *Paradisi in Sole Paradisus Terristris*, or *A garden of all sorts of pleasant flowers which our English ayre will permitt to be nourised up . . .* London, printed by H. Lownes and R. Young, 1629. Arber notes that *Paradisi in Sole* can be translated as Park In Sun, a pun upon the author's name. Of greater botanical importance is Parkinson's *Theatrum Botanicum: The Theater of Plants*, printed in London by T. Cotes in 1640. Arber writes: "According to the preface to the *Paradisus Terrestris*, the author's original idea was merely to supplement his description of the *Flower Garden* by an account of *A Garden of Simples*. This scheme grew into one of a more extensive and general nature, but without losing the predominant medical interest which would have characterised the work as originally planned. In accordance with the intention, the virtues of the herbs are dealt with in great detail."

More modern works of rare occurrence include the *Mushroom Book* by Lois Long. This gift was presented to the library in 1976 by the late world acknowledged mycologist, Dr. Alexander H. Smith through the auspices of Duane Mitchel, M.D., a local physician, mycologist of renown and authority on Agaricales. This large volume depicts 12 lithographs of Lois Long, accompanied by the botanical descriptions by Dr. Smith and annotated by John Cage, contemporary music composer. The library owns number 39 of a total printing of 75 copies.

In 1986 the library acquired the 13 volumes of Benjamin Maund's *The Botanic Garden*, published beginning in 1825, from a local bookstore at an excellent price. The books, profusely illustrated, represent hardy ornamental flowering plants cultivated in Great Britain with their names, classes, orders, history, qualities, culture, and physiological characteristics. Accompanying these are Maund's *The Auctarium of the Botanic Garden*, 1849, and *The Floral Register, A Dictionary of English-Latine Terms*, 1850, and *The Fruitist*, 1850.

In 1973, the library received a gift of 81 early American botanical books from Mr. and Mrs. Erle Ellis, collectors of Western Americana. This donation contained a large part of the writings of Asa Gray, 1810-1888, whose botany textbooks were fundamental to the teaching of botany in the U.S. for over fifty years. Also represented in the donation are works of John Torrev, as well as reports of the Pacific Railroad Surveys and the U.S. Geological Surveys. The gift of Dr. and Mrs. Moras Shubert in August 1986 of 12 volumes of the Railroad Surveys, 1853-54 (Reports of explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean) enriched this part of the collection.

The Waring Rare Book Room collection was featured to enhance the Smithsonian Institution displays held at DBG. The loan of locked cases from the Kath-

ryn Kalmbach herbarium has allowed the herbals to be seen by all who have attended these exhibits. Mrs. Kalmbach, for whom the herbarium is named, also collected botanical and horticultural stamps now in WRBR. These are arranged by plant family in alphabetical order in five philatelic notebooks. The accumulation of botanical and horticultural stamps continues chiefly through donations from well-traveled volunteers and staff.

Use of the WRBR

Although the room is kept closed at all times to maintain the proper temperature and humidity, its use is not restricted. The staff, especially those involved in DBG publications, have been rewarded in their searches for illustrations in the public domain, illustrations for reproduction for which there is no charge. At the numerous art exhibits which have been held at DBG, many prints have been displayed, for sale and for viewing. The WRBR has many of the originals, bound as these were always intended to be. Artists have utilized the collection for inspiration and enrichment. Historians can verify and document their research as in the case of Bob Heapes who found a surprising wealth of information in the WRBR for his work on early American botanists. Mr. Heapes used the illustrations from the books and of the bindings to enrich his presentation. Botanists seeking original data on plants have also satisfied some of their queries. Horticulturists have been able to study the first description of orchid and iris hybrids. Book collectors can examine the WRBR holdings to compare the offerings of dealers.

On an annual basis, the books are inventoried and cleaned by the summer college interns, this task being given to one or more who seem to be thrilled by the assignment. A register of patrons is kept in the WRBR for all who visit to sign. The room is open by appointment to anyone requesting the pleasure.

Book Review: *Rare Plants of Colorado*

by Velma Richards

"Exquisite," "the most complete data available," "a wonderful detective story"—all are comments of readers describing the newly published softcover book, *Rare Plants of Colorado*. Three years in preparation, the book was compiled and published by the Colorado Native Plant Society in cooperation with the Rocky Mountain Nature Association. These are stories of discoveries—some long ago and some more recent—and of sleuthing in herbaria and in diaries of early botanical explorers. There are tales of keen-eyed observations in remote places by present-day botanists. Some of the species never again have been reported since their original discovery many years ago. The only evidence of their existence is from herbarium specimens and other historical records.

Of the 92 species included, a few are listed as "Threatened" or "Endangered" by the federal Endangered Species Act. The others are included in *Colorado Species of Special Concern* compiled by the Colorado Natural Areas Program, a state agency concerned with identifying and providing protection for important natural features of the state.

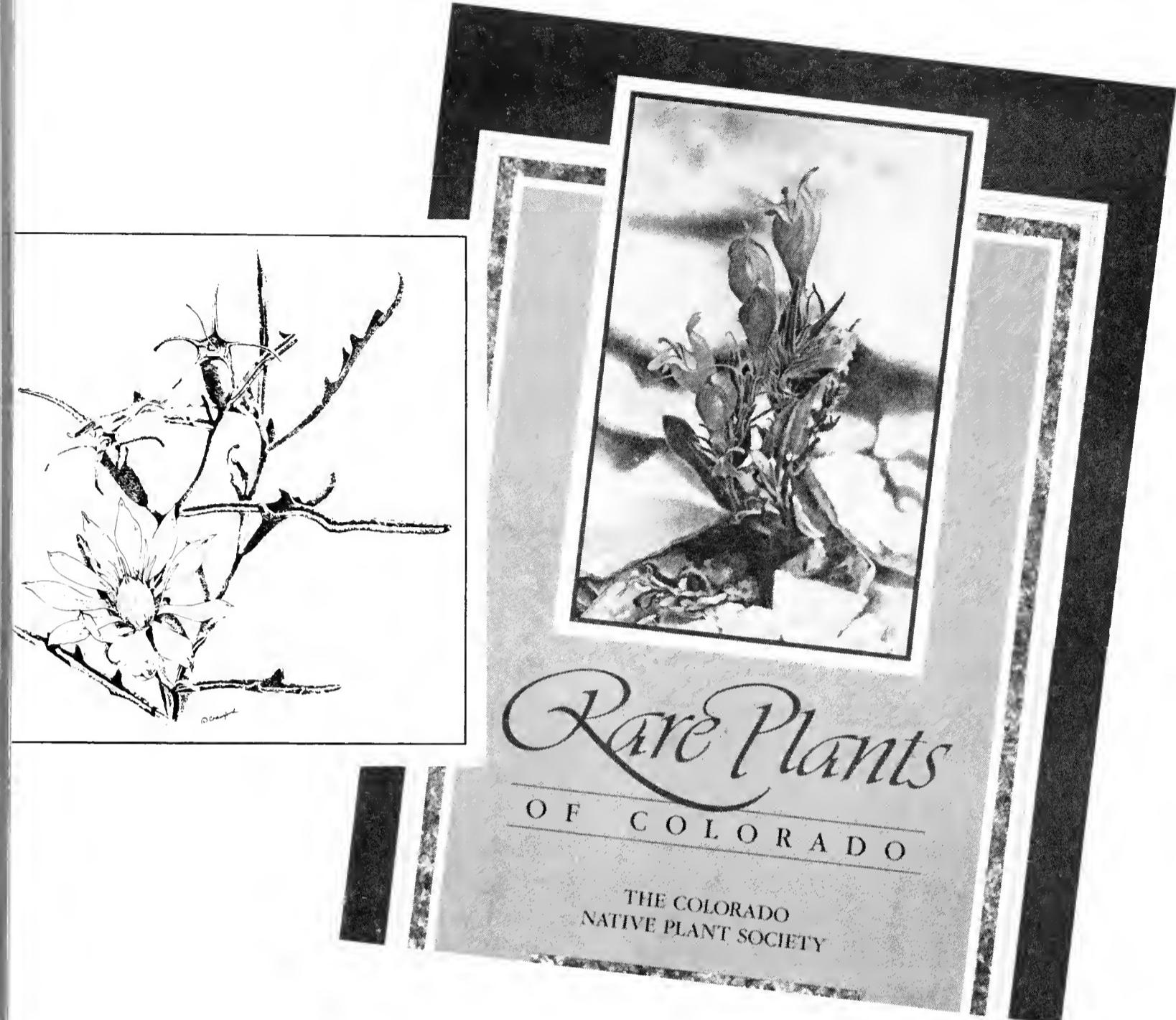
The species are arranged under eight major habitats: alpine tundra, barrens,

cliffs and canyons, forests, grasslands, shrublands, wetlands and woodlands. Each chapter, accompanied by a full-page photograph, is introduced by a discussion of the general features of the habitat—its plant communities, its geology and climate, its historical uses and other interesting facts. The index lists the plants by both common and scientific names.

Each species is illustrated with a colored photograph, a colored pencil rendering or a black and white line drawing. A county location map pinpoints the areas where the plant has been found. The microhabitat often so vital to the plant's survival is described, and potential threats endangering its existence are frequently discussed. For example, once-common plants, such as the showy tulip gentian of the grasslands, have been extirpated in many areas by urban development. The brilliant wood lily of the forests and the Knowlton's miniature cactus of the woodlands are threatened by collection for personal or commercial uses.

Historical facts about the discovery and naming of species make interesting reading. The giant helleborine orchid was first reported in Colorado in 1887 by Emma Thayer. In her book *Wild Flowers of the Rocky Mountains* she wrote of her trip to Pagosa Springs: ". . . One of the attendants at the springs told me of a very rare flower . . . he had in a vase in his room . . . I discovered it to be a wild

Velma Richards is past Editor of *The Green Thumb*, a volunteer at the Kathryn Kalmbach Herbarium and a member of the board of the Colorado Native Plant Society.



orchid. The blossom was about the size of a silver dollar and it had the rich brown markings so peculiar to the orchid. I regretted exceedingly that it had been broken from the plant so long that a correct painting could not be given of it." The photograph accompanying the description was taken in 1986 in the same population, attesting to the importance of preserving rare plant habitats.

A fascinating botanical detective story is told of the rediscovery of rock-loving neoparrya, a member of the parsley family, 90 years after it had last been seen. Also described are the discoveries of five new species for the state through recent botanical surveys of oil shale outcrops in western Colorado.

The Colorado Native Plant Society hopes that this book will stimulate further study of the rare plants of Colorado and motivate action by the citizens of the state to preserve for posterity the habitats in which these plants grow.

Rare Plants of Colorado is now available at Colorado State Park or National Park visitor centers, the Denver Botanic Gardens gift shop and selected bookstores in the area. It may also be ordered direct from the Rocky Mountain Nature Association, Rocky Mountain National Park, Estes Park, CO 80517, at \$7.95 per copy plus 3% sales tax. Shipping charges are: Order under \$10 — \$2.50, 10-20 — \$3.00, over \$20.00 — \$3.50.



Thank you, Velma

Velma Richards served as editor of *The Green Thumb* magazine from Autumn 1981 to Autumn 1988. We take this opportunity to extend our deepest thanks to her for producing a periodical of the highest standard. Velma sought out knowledgeable contributors to give us wide-ranging articles on the natural history and practice of botany and horticulture in the Rocky Mountains. Her professional editing and scholarship maintained a tradition of excellence for the magazine. Her involvement with *The Green Thumb* continues through her participation on the Editorial Committee where her experience is of invaluable service.

Few people realize the full extent of Velma's activities at Denver Botanic Gardens. Since 1977, she has been a volunteer at the Kathryn Kalmbach Herbarium. Her peers there find her inquiring mind and cheerful enthusiasm an inspiration. She assisted in several plant surveys in Colorado, including the Florissant Fossil Beds, South Table Mountain and DBG's Walter S. Reed Botanic Garden. During the first year of the DBG survey of Rocky Mountain National Park, the alluvial fan of Horseshoe Park captured her imagination and became the focus of her attention. Her keen powers of observation paid big dividends when she discovered several colonies of *Mimulus gemmiparus*, an extremely rare monkey flower growing on the fan. At the

end of the summer, she eagerly accepted an invitation to accompany Loraine Yeatts on a backpack to hunt for a rare fern, Velma's first backpacking venture.

Velma's gifts as a teacher serve DBG well in several areas: she is a volunteer guide, a teacher of guides, a field trip leader and has been a member of the Education Committee. She was instrumental in developing the SKIP kit (School Kids Into Plants), an educational tool for use by elementary school students in conjunction with their tours of DGB.

Velma is also a valuable member of the Colorado Native Plant Society, currently serving on its board. The CoNPS publication, *Rare Plants of Colorado*, exhibits her editing expertise. She helped assemble a volunteer group of CoNPS members to work with Rocky Mountain National Park research biologist Richard Keigley in a revegetation study involving seed identification and dispersal.

In addition to these numerous activities, Velma enjoys traveling with her husband and spending time with her grandchildren. Denver Botanic Gardens is indeed fortunate to have such an energetic and thoughtful person in its ranks of volunteers.

This tribute to Velma represents the joint efforts of the Herbarium Committee and the Editorial Committee.

Indices

Subject Index 1989

(Spring/Summer 1-32; Autumn/Winter 33-64)

Bonsai

Bonsai: An Interview with Harold Sasaki, 40

Books

Rare Plants of Colorado, Review, Velma Richards, 62

The Waring Rare Book Room, Solange Gignac, 59

Botanical Illustrators

Carolyn Crawford, Botanical Illustrator, Bernice Peterson, 16

Butterflies

Attracting Butterflies, Paul Opler and Whitney Cranshaw, 24

Watching Butterflies, Alcinda Cundiff, 29

Conservation

The Center for Plant Conservation, Carol Dawson, 19

Rare Plants of Colorado, Review, Velma Richards, 62

Societies: Native Plants and Conservation, 51

Denver

Bridging the Turn of the Century, Don and Carolyn Etter, 1

Denver Botanic Gardens

The Center for Plant Conservation, Carol Dawson, 19

The Waring Rare Book Room, Solange Gignac, 59

Thank You, Velma, 64

Forests

Forests of Colorado, 49

Grasses

Exotics of Colorado, Helen Marsh Zeiner, 22

Ornamental Grasses, Gayle Weinstein, 13

Horticulture

Attracting Butterflies, Paul Opler and Whitney Cranshaw, 24

Bonsai: An Interview with Harold Sasaki, 40

Trees and Trout: A Colorado Forest in a Suburb, Alcinda Cundiff, 45

Ornamental Grasses, Gayle Weinstein, 13

Ornamental Trees to Tailor for the Small Garden, Larry Watson, 33

Herbs for You, Gloria Falkenberg, 52

Herbs

Herbs for You, Gloria Falkenberg, 52

Native Plants-Wildflowers

Attracting Butterflies, Paul Opler and Whitney Cranshaw, 24

The Center for Plant Conservation, Carol Dawson, 1

Forests of Colorado, 49

Societies: Native Plants and Conservation, 51

Trees

Bonsai: An Interview with Harold Sasaki, 40

Forests of Colorado, 49

Trees and Trout: A Colorado Forest in a Suburb, Alcinda Cundiff, 45

Ornamental Trees to Tailor for the Small Garden, Larry Watson, 33

Author Index 1989

Cranshaw, Whitney	24
Cundiff, Alcinda	29, 45
Dawson, Carol	19
Etter, Don and Carolyn	1
Falkenberg, Gloria	52
Gignac, Solange	59
Opler, Paul	24
Petersen, Bernice	16
Richards, Velma	62
Watson, Larry	33
Weinstein, Gayle	13
Zeiner, Helen Marsh	22

Index of Illustrators 1989

Crawford, Carolyn	13-14, 17, S/S back cover
Center for Plant Conservation, courtesy of	20
Colorado Native Plant Society and Rocky Mountain Nature Association, courtesy of	63
Cundiff, Alcinda	31
Denver Public Library, Western History Dept., courtesy of (map)	5
Denver Botanic Gardens, photo collection	54, 57
Feucht, James	34, 37, 39
Gerarde, John	59
Grote, Karen	12
Hall, Deane (photos) 6-7, 10-11, 16-17, 40, 41, 43-44, 59-60	
Hansen, Frances Frakes	S/S, A/W front cover
Hyll, Thomas	53
Jones, Clive (photos)	8
Lewis, Clayton (photos)	45, 46, 48
Linhart, Yan (photos)	49, 50
Long, Lois	60
Markham, Gervase	53
Mattioli, Petri	52, 55
Opler, Paul (photos)	24-26, 28
Peacock, Doris	23
Proctor, Rob	56
Schichtel Nursery Catalogue	33-39
Yeatts, Loraine	64

The Green Thumb

Denver Botanic Gardens, Inc.

A Non-Profit Organization

Sent to all members of Denver Botanic Gardens. Membership fees are as follows: Student \$18, Individual Senior Citizen \$18, Senior Couple \$25, Individual \$25, Family/Dual \$35, Contributing \$50, Supporting \$100, Patron \$500, Benefactor \$1000.

By becoming a member of Denver Botanic Gardens, Inc., you will receive *The Green Thumb* and the monthly *Green Thumb News*. You will also have year-round admission to the gardens and unlimited access to the use of the books in the Helen K. Fowler Library, located in Boettcher Memorial Center at 1005 York Street.

For further information, write to Membership Chairman, Botanic Gardens House, 909 York Street, Denver, Colorado 80206, or call 331-4000.

Denver Botanic Gardens, Inc., maintains a collection of living plants, both native and exotic, for the purpose of acquiring, advancing and spreading botanical and horticultural knowledge.

This is a non-profit organization supported by municipal and private funds.

Denver Botanic Gardens, Inc.
909 York Street
Denver, Colorado 80206

NON-PROFIT ORG.
U.S. POSTAGE PAID
Permit No. 205 Denver, Colorado



079046
EW

